Workforce Competency Dictionary

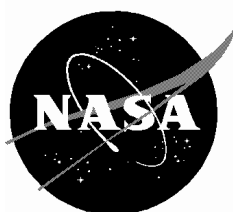## NASA Competency
Management System (CMS)

CMS-DOC-01

OFFICE OF HUMAN CAPITAL MANAGEMENT
Issue Date: 04-17-2006
Revision: 6a

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National Aeronautics and
Space Administration

Headquarters
Washington, DC

PREFACE

PURPOSE

The NASA Competency Management System (CMS) is a collection of business processes and tools that are used to measure and monitor the Agency's corporate knowledge base. A competency is a conceptual representation of a body of knowledge. The competencies are used to categorize the capabilities of an employee, identify the knowledge requirements of a job position, forecast the workforce requirements for a project, and stimulate the interaction and sharing of knowledge across the Agency.

CMS USAGE POLICY

Intended Use

Strategic Human Capital Management: The Competency Management System is primarily a workforce-planning tool that will help the Agency ensure it has the competencies needed for the future workforce. It identifies competencies for employees, job positions, and program/projects. By combining this data with other related information (such as project schedules, mission priorities, allocated resources, etc.), it provides insight into the Agency's workforce capabilities, which enables appropriate decision makers to set guidelines for human capital programs (such as staffing, training, etc.). The program managers can use the competency information to augment other workforce information to align the workforce to the Agency's mission.

Integration of Business Processes: The Competency Management System provides a frame of reference. This allows business processes that are related, to map their objectives and data to competencies. This allows the exchange and integration of information between the processes utilizing a common language.

Employee Development: The Competency Management System provides employees and supervisors an additional avenue to help determine the knowledge areas. This sets the focus for defining the appropriate developmental activities that would further enhance the employee's capabilities.

Expertise Locator: The Competency Management System provides employees, supervisors, project managers, functional offices, enterprise management, and senior leadership the capability to locate expertise within the Agency's Workforce. It provides insight the Agency's Corporate Knowledge Base

Knowledge Management: The Competency Management System can help connect employees with the same or similar competencies into communities of practice. This allows other systems and tools, such as portals, to more easily connect the community with other knowledge management tools (such as Lessons Learned, Technical Documents, etc.) that are similar or related to the competency.

Communication Tool: The Competency Management System provides a mechanism to understand the Agency's Corporate Knowledge Base that enables improved communication across project, functional, and organizational boundaries in an effort to realize and apply the full capability of the workforce to accomplish NASA's mission by providing a consistent language and framework.

Restrictions and Limitations

Job Selection: The Competency Management System is not designed or used as an Agency employment and selection system. It does not meet, nor is required to meet, the Uniform Guidelines on Employee Selection Procedures (29 CFR 1607). When defining a job, competencies relate to, and can help define, the knowledge requirements for the position.

But there are several other qualifications factors (such a duties, skills, abilities, location, job environment, etc.) that are defined and used during the competitive selection process. [For detailed information about the job selection process, see the NASA HR Desk Procedure on "The NASA Competitive Placement Plan for Positions GS-15 and Below (Including Trades and Labor Positions)"]

Pay Setting: Most employees are in pay systems that are position-based. This means that basic pay is determined by the classification of the duties and responsibilities of the position to a particular grade or pay level. The intent of the federal pay system is to ensure that there will be equal pay for equal work. Competencies help to define the Knowledge part of the position requirements. Some competencies are required for a position and help to determine grade and pay. However, these competencies are defined and delineated via the job analysis and classification process, NOT through CMS. Other competencies an employee may possess are associated with an individual and do NOT apply to grade or pay determination. [For detailed information about pay setting, see the NASA Desk Guide on "Pay Setting")

Employee Performance Evaluation: An employee's performance plan will be based on an employee's work assignments and responsibilities and must contain at least one element that addresses the individual's performance and its relationship to NASA`s Strategic Plan. Competencies are a body of knowledge and therefore cannot be used to plan or evaluate employee performance. [For detailed information about employee performance, see the NASA Policy Guide 3430.1A "NASA Employee Performance Communication System (EPCS)"]

Task/Work Assignments: Competency information can provide supervisors with limited information about what an employee may know. It does not capture or communicate the other items that a supervisor would need in order to assign an employee to a particular task or job, such as how the employee applied their knowledge (which projects, products, tasks) how the employee performs, other special skills or capabilities that an employee may posses, availability of the employee, among others. The Competency Management System is not intended to replace supervisor judgment or direct communication with employees. [For detailed information about work assignments, contact your supervisor]

Other: Any application, or use of the competency data must comply with all related NASA HR Policies and Guidelines.

Privacy Act Notice:
Records that relate to employees contained in the Competency Management System (CMS) are subject to the Privacy Act and must be safeguarded against unauthorized disclosure in accordance with 14 C.F.R. 1212.605. Unauthorized disclosure of Privacy Act records may result in criminal penalties under 5 U.S.C. 552a(i)(1) and (2).

Disclaimer

The content in this section on the CMS Usage Policy is provided to the reader as a synopsis of how the competency information and implementation relates to selected NASA Human Resource Policies and Procedures, which are governed by extensive Federal Laws, Regulations, and Guidelines. This information does not supplement or supersede any NASA Agency, or Center, HR Policy or desk procedure. For any questions about competency information as it relates to personnel actions please contact the Human Resource Office at your Center.

BUSINESS RULES & GUIDELINES

(1) Guidelines for the number of competencies per position: The intent of the process is to identify competencies that are required for a job position AND that would be utilized most of the time, or are critical knowledge areas for the position. It is not the intent of the system to capture every possible competency that could be used. Every position should have at least one competency identified, and for most positions it is expected there will be anywhere between 2 and 10 competencies assigned. The CMS system has enough fields to accommodate up to 20 competencies for any position, however, it is expected that there will be few positions that will need to be assigned more than 10 competencies.

(2) Guidelines for the number of competencies per employee: Individuals are to identify the areas of knowledge that they have acquired through past education or work experience. However, it is not feasible, nor the intent of this system, to capture everything a person may know. Therefore, the employee should limit and select the competencies that best describe the knowledge areas that they have utilize most often in the present, or in the past. At a minimum, these should include the competencies that they are using in their current job position. Additional competencies should reflect only those bodies of knowledge that employees feel are current enough to be usable, with or without some refresher development, to a maximum of 20 competencies per person.

(3) Rules for Primary Competency: For every job position, one of the required competencies should be designated as a "primary" competency. It should be the one that best describes, or represents, the knowledge that is utilized the most over a given fiscal year. All competencies identified for a job position are considered of equal value. The primary competency is used during the workforce planning process to help simplify forecasting and the data analysis.

(4) Rules for identifying required competencies for specific position types:
- Senior Executive Service (SES) All Senior Executive Positions will automatically be assigned Executive Management as a primary competency. (ref section 4.1.1) They will also automatically be assigned all of the level 2 NASA Leadership Knowledge Domain competencies. (see section 4.2.2 for the complete listing) They should identify any other appropriate technical competencies that directly relate to the knowledge needed for the functional responsibilities of the position. The Senior Executive position is designated by a supervisory code of 2 and either of the following NASA Classification Codes: 67701 or 77001.
- Supervisory Positions All supervisory positions (designated in the Federal Personnel & Payroll System by a supervisory code of 2) will be automatically assigned one of the following Supervisory Competency Clusters below, depending on their NASA Classification Code. The Supervisory Competency Cluster will be automatically designated as the primary competency. In addition, all of the competencies that comprise the cluster will also be automatically added to the job position. Other appropriate technical competencies may be added as additional knowledge requirements for the job position. These additions should be made per the normal business operations of the system and HR policies.
  - Project Work & Team Management:
    77010, 77060, 77061
  - Technical Work & Team Management:
    All 605, 700, and 900 series except 77010, 77060, 77061 & (77001 SES)
    Also 20101, 24501, 28501, 30107, 30113, 30501, 31502, 35501, 35502
  - Business Work & Team Management:
    All other positions that do not fall into the first two categories, except for SES (67701 &77001)
- Technicians should have Engineering and Science Support (11) as the primary competency with other technical competencies as secondary
- Administrative Officers should have Professional Administrative Operations (115) as the primary competency and other competencies as secondary. (*Example: Financial Management, Budgeting Management, etc.*) All positions classified as OPM Series 341 will be automatically assigned this competency as primary by the CMS tool.
- Secretary positions should have Para-Professional Business Operations (165) as the primary competency. All positions classified as OPM Series 303 & 318 will be automatically assigned this competency as primary by the CMS tool.
- Student trainees/co-ops will be tracked and planned for as part of the workforce planning process. Student Trainee positions will be assigned a generic competency as their primary for planning purposes. The Centers can further define the knowledge specialty of the student position by assigning one, or more specific technical competencies as a requirement for the position. The following competency assignments will be made to the student trainee position based on the NCC classification:
  - Technical Student Trainee Positions, classified as NCC 340-XX, will be assigned the "Technical Student Trainee" (1101) as their primary competency.
  - Clerical Student Trainee Positions, classified as NCC 501-02, will be assigned the "Clerical Student Trainee" (1102) as their primary competency.

- ▪ Professional Administrative Student Trainee Positions, classified as NCC 509-10, 509-12, 510-09, 513-02, 515-03, 516-02, 519-02, 551-02, 560-06, 570-03, 570-04, 576-04, 586-01, 591-02, 591-03, and 596-02, will be assigned the "Professional Administrative Student Trainee" (1103) as their primary competency.

Any exceptions to these business rules should be reviewed with Center CMS representatives

(5) Guidelines for Levels of Proficiency: Proficiency is a measurement of an employee's demonstrated level of capability utilizing the associated body of knowledge. It categorizes the depth of knowledge within any single competency or subcompetency. Reference the "Proficiency Guideline Table" in Appendix B.

REVISION HISTORY

REVISION	DATE	COMP ID	CHANGE
6a	4/5/2006		See Appendix C for a summary of changes made to this revision.
6	12/7/2005		See Appendix C for a summary of changes made to this revision.
5a	10/8/2005		The Business rules were modified for the Administrative Officers, Secretary positions, and Student Trainees/coops. RCN 06-005
		174	(new) Level1 competency "Student Trainee" was added to the dictionary section 1.4.6 . RCN 06-001.
		1101	(new) Level2 subcompetency "Technical Student Trainee" was added to the dictionary section 1.4.6.1. RCN 06-002.
		1102	(new) Level2 subcompetency "Clerical Student Trainee" was added to the dictionary section 1.4.6.2. RCN 06-003.
		1103	(new) Level2 subcompetency "Professional Administrative Student Trainee" was added to the dictionary section 1.4.6.3. RCN 06-004.
5	10/8/2004		See CMS-DOC-16 Revision 5 Change Catalog Rev 09-30-2004 for a complete history of changes made during this revision.
4b	2/3/2004		NO CHANGES WERE MADE TO COMPETENCIES Preface was added. Index was added Cross Reference Table was added.
4a	1/21/2004		NO CHANGES WERE MADE TO COMPETENCIES New Competency Groupings replaced the previous hierarchy.
4	7/21/2003	64	Analytical and Computational Structural Methods has been clarified as a research competency and is applicable to structures discipline
		122	Program/Project Management was modified to separate out knowledge associated with program/project analysis (147).
		126	Physical Security was modified to separate out knowledge associated with export control (144).

REVISION	DATE	COMP ID	CHANGE
		130	Occupational and Environmental Health & Safety was expanded.
		132	Facilities Planning and Operations has been renamed and subdivided into 4 new competencies: ▪ Institutional Facilities Planning (145) ▪ Institutional Facilities Operations (146) ▪ Research Facilities Planning (132) ▪ Research Facilities Operations (148)
		138	(new) Nuclear Engineering has been added.
		139	(new) Software Assurance Engineering has been added.
		140	(new) Leadership has been added.
		141	(new) Personal Communication has been added.
		142	(new) Relationship Management has been added.
		143	(new) Fire Protection Engineering has been added.
		144	(new) Export Control has been added.
		145	(new) Institutional Facilities Planning has been added.
		146	(new) Institutional Facilities Operations has been added.
		147	(new) Program/Project Analysis has been added.
		148	(new) Research Facilities Operations has been added.
3			BASELINE – First dictionary approved by the Competency Management System Agency Implementation Team
2			WORKING DRAFT
1	12/12/2002		INITIAL DRAFT

1. Business Knowledge Domain

1.1. Business Operations Competency Suite

1.1.1. Partnership & Business Development   (BUSDEV) [116]

Knowledge, capabilities and practices associated with the effective targeting and acquisition of external partnerships and business opportunities, including funding opportunities for projects and programs Includes an understanding of the Agency's strategic plan, the ability to identify, assess and forecast new business opportunities such as technology transfer, leasing, enhanced use leasing, and develop and use appropriate marketing strategies. Requires knowledge of relevant markets, customer needs in those markets, and an ability to recognize and analyze market trends. Involves development,or assessment, of proposals to win business, and management of existing agreements with external entities such as industry, government, university, and international partnerships. Also includes knowledge of Space Act Agreements, and an ability to facilitate and manage partnerships that support Agency strategies, partner requirements and Space Act provisions. Ability to integrate and work with the appropriate elements of the agency's technical and support communities.

1.1.2. Business IT Systems   (BITSYS) [131]

Knowledge, capabilities and practices associated with computer architectures and computer-based information systems related to business operations and mission support. This competency is based on knowledge comprised from one or more of the following interrelated technologies: computer and other hardware, programming languages, commercial operating systems, web or database systems, network hardware and software, IT security and other technologies that pertain to the acquisition, computation, storage, distribution, reporting, and management of information.

1.1.2.1.   Information Resources Planning and Evaluation   (BITPLAN) [1078]

Knowledge of the principles, methods, and techniques of IT assessment, planning, management, monitoring, and evaluation, such as IT baseline assessment, interagency functional analysis, contingency planning, and disaster recovery.

1.1.2.2.   IT Architecture   (BITARCH) [1079]

Knowledge of architectural methodologies used in the design and development of information systems, including physical structure of a system's internal operations and interactions with other systems.This may also include the knowledge of enterprise achitecure principles, methods, and tools utilized to simplify processes and unify work across agencies and within the lines-of-business of the Federal Government. This could also includet heknowledge of the princilpes, tools, and technquies used to design, develop, and/or implement Knolwedge Management practices at a local or enterprise level.

1.1.2.3.   Information Systems Security   (BITSECURE) [1081]

Knowledge of methods, tools, and procedures, including development of information security plans, to prevent information systems vulnerabilities, and provide or restore security of information systems and network services. May also include the knowledge of the principles, methods, and tools for evaluating information systems security features against a set of specified security requirements.

1.1.3. Business Management (BUSMMT) [113]

Knowledge of principles and practices related to managing the internal and external operations of a business unit, such as a Center, to accomplish mission objectives and goals efficiently. Includes ability to integrate performance goals with budget and financial resources as well as the ability to achieve customer satisfaction, develop strong relationships with other NASA and external entities, and adhere to agencywide programs, policies, and procedures. Understanding ofAgency and federal government financial, budget and performance operations and processes, and how to apply these processes to optimize operational and investment decisions.

1.1.4. Commercial Technology (COMTEC) [117]

Knowledge and abilities associated with transferring current and future Agency technology to external entities in order to meet broad Agency vision and missions, and extend the lifecycle and broaden the usefulness of Agency technologies. Involves expertise in business practices pertaining to intellectual property, patents, licenses and partnerships as well as general business knowledge for assessing potential partners. Includes broad understanding of Agency technologies and programs, as well as familiarity with external entities and markets.

1.1.5. Education Programs and Technologies (EDTECH) [137]

Knowledge, capabilities and practices associated with the research and application of education programs, standards, requirements, activities and services relevant to the fields and disciplines of science, technology, engineering, and mathematics (STEM) within the contexts of pre-college, higher education, and non-traditional learning. Includes knowledge of education concepts and principles, curriculum development, infrastructure, audiences, instructional technologies and distance learning tools, and trends in order for NASA to appropriately influence and contribute to national and state education initiatives and requirements through the use of NASA's unique assets. Includes knowledge of NASA Enterprise and Center-based research and technology needs, and ability to align education activities and programs with these needs. Includes knowledge of demographic and geographic dynamics that influence the educational effectiveness and success within the various student and educator communities.

1.1.6. Export Control (EXPORT) [144]

Knowledge, capabilities, and practices associated with complying with federal laws controlling the export of items and technical data. This includes the formulation and implementation of export control policy, plans, and procedures that ensure compliance with federal law. The primary focus of export control it to ensure compliance through programs, education of the workforce, and addressing unique situations in the aerospace environment.

1.1.7. Governmental Affairs (GOVAF) [136]

Knowledge of NASA-related legislation, the legislative process and public affairs as it pertains to NASA. Includes the ability to monitor legislation that is of interest to NASA, monitor NASA-related hearings and markups scheduled before the House and Senate committees and subcommittees that have oversight over NASA, to especially include Authorization and Appropriations subcommittees. Ability to help manage NASA press releases of Congressional interest and identify key members and issues of importance to them. Broad knowledge of NASA programs and specific knowledge of local center programs.

1.1.8. Inspection, Investigation and Compliance (INSCOMP) [127]

Knowledge of how to provide objective evaluation of Agency standards and operation through use of inspection and investigation techniques and compliance audits. Understanding of how to assess risk, evaluate evidence, design and conduct inquiries such as inspections and investigations, and make recommendations to prevent, detect or solve crime, fraud, waste and abuse and ensure efficient Agency operations. Involves understanding of how to communicate information to constituents, including Agency leadership and management, employees, and Congress.

1.1.9. Legal Assistance   (LEGALSUP) [176]

Other knowledge of legal research and writing, litigation case management, and providing professional administrative and technical legal support, not otherwise categorized.

1.1.9.1.   Paralegal   (PARALEGAL) [1082]

Knowledge of legal research and writing, litigation case management, and providing professional administrative and technical legal support. Possesses paralegal certificate or equivalent

1.1.9.2.   Patent Agent   (PATENTAGT) [1114]

Knowledge of intellectual property matters, patents, copyrights, data rights, trademarks, and commercilization of technology. Must be admitted to the practice before U.S. Patent Office, but not necessarily liscensed to practice law.

1.1.10. Legal Application Practice   (LEGALAPP) [125]

Member in good standing of the bar of either a Federal court or the highest court of any state in the United States or the District of Columbia. Knowledge, capabilities and practices associated with representation, counseling, advising, researching, performing, and / or supervising professional legal work in the administration of applicable statutes, regulations, Executive Orders, rules, and case law. This includes knowledge of topics such as, but not limited to civil and administrative law, procurement, claims, , fiscal matters, personnel matters, environmental matters, FOIA, Congressional inquiries, ethics, intellectual property and data rights, litigation, and appeals.

1.1.10.1.   Intellectual Property Law   (INTPROPLAW) [1083]

Speciaized knowledge of matter related to intellectual property, including but not limited to patents, copyrights, data rights, trademarks, and commercialization of technology. Be in good standing to practice before the United States Patent and Trademark Office.

1.1.10.2.   General Law   (GENERALLAW) [1084]

. Speciaized knowledge of matters related to civil and administrative law, including but not limited to fiscal and appropriations law, ethics, FOIA, torts, privacy issues, export control, immigration and foreign visitors, and litigation and appeals.

1.1.10.3.   Contracts Law   (CONTRCTLAW) [1085]

Speciaized knowledge of matters related to procurement, including but not limited to contracts, grants, cooperative agreements, Space Act agreements, source selections, claims, protests, and litigation and appeals related to procurement matters .

1.1.10.4.   Personnel/EEO Law   (PERSONLAW) [1086]

Speciaized knowledge of matters related to employee and personnel issues, including but not limited to employee discipline and performance matters, MSPB, labor unions and collective bargaining, EEO, ADR, and litigation and appeals related to employment and personnel matters.

1.1.10.5. Environmental/Real Property Law (ENVLAW) [1087]

Speciaized knowledge of matters related to environmental matters, inclucing but not limited to of local, state and Federal environmental laws, regulations, Executive Orders, and administrative procedures, NEPA, permits, response or corrective actions, pollution prevention, and litigation and appeals related to environmental matters.

1.1.10.6. International Law (INTLLAW) [1112]

Knowledge of public international law, space law, international agreement drafting, conclusion, procedure and interpretation, international jurisprudence, Space Act Agreements, inter-agency procdedures concerning international agreements (C-175), negotiation skills and general knowledge concerning all other areas of law (e.g., IP, ethics, contracts, environmental).

1.1.10.7. Commercial Law (COMMLAW) [1113]

Knowledge of negotiating, drafting, and interpreting Space Act Agreements with domestic and foreign entities; compliance with export-import control regulations; and partnering arrangements with commercial organizations. Knowledge related to intellectual property law and commercialization of NASA activities, in addition to policy, legislative drafting, negotiating and drafting agreements, and providing legal advice and reviews.

1.1.11. Public Communications & Outreach (PUBLICOMM) [135]

Knowledge, capabilities and practices associated with the assessment, development and execution of public communication and outreach efforts. Knowledge of effective public relations and presentation techniques for representing and expressing the views, work operations and policies of NASA including liaising with and presenting information to a variety of external audiences. Effectively advocates for the Agency through communication of the organization's expertise and contributions, and assessing the effectiveness of past or ongoing efforts. Apply principles and practices of domestic and international customs, regulations and details to ceremonies or other interaction with distinguished visitors or in public forums. Manage Agency knowledge so it can be accessed where and when needed for communication purposes inside and outside the Agency. This includes public writing and speaking, information collection and dissemination, news broadcasting and writing, media relations, exhibit design, story development, visitor and guest programs, protocols, and concessionaire management.

1.1.12. International Program Development (INTLPGMDEV) [157]

This competency refers to the knowledge and capabilities associated with establishing international programs/agreements through international negotiations, drafting international agreements that comply with U.S. laws and regulations, arranging negotiation meetings, understanding the protocol issues involved in meetings, signing ceremonies, meetings between heads of agencies and NASA, exchange of gifts, liaison with Department of State and other U.S. Agencies and Departments. This may involve both reimbursable and non-reimbursable agreements.

1.1.13. Policy Management (POLICYMGMT) [169]

Knowledge of NASA relationships to headquarters, Centers, component facilities, partnerships and other government agencies, including international governments, in order to effectively integrate services consistent with broad strategies and objectives. Requires the capability to research and apply government-wide laws and Agency operating principles, regulations, and policies associated with organizational and business functions such as financial, human resources, legal, security, communications, inspection, compliance, and health and safety.   Utilizes a wide variety of resources and tools to develop, maintain, monitor, enforce and provide oversight of NASA management requirements.

1.2. Financial Operations Competency Suite

1.2.1. Budgeting Management   (BUDGETMMT) [119]

Knowledge of how to apply management knowledge, principles and practices to obtain, utilize, manage financial resources in the workplace to meet program, project or business requirements. Involves maintaining available resources, making resource decisions based on need and availability, and developing and implementing strategies to make rational and well thought-out decisions related to organizational resources. Includes the ability to provide guidance, formulate a budget plan, defend a budget plan, assess budget performance, advocate budget and alternative scenarios and execute a budget plan. Requires knowledge of policies and practices related to Federal, Agency and Installation accounting, and internal business information systems.

1.2.2. Acquisition and Contract Management   (CONMMT) [124]

Knowledge, capabilities and practices associated with each phase of the acquisition and contract management lifecycle including requirement analysis, market research, acquisition planning and strategy, solicitation, proposal evaluation, negotiation, determination of price reasonableness, selection, contract management, and performance assessment. Requires understanding of applicable public laws, executive orders, Federal regulations, Agency requirements, policies, and initiatives. Requires knowledge of contracts to review products and services to determine if they are in compliance with contract terms and conditions. Includes ability to assess technical requirements needed to support program and project implementation and provide guidance and direction to contractors to ensure delivery and quality of services and products. Ability to use contract or acquisition instruments and surveillance systems as necessary to ensure contract or acquisition requirements are being met throughout the life of the contract.

1.2.2.1. Acquisition Planning   (ACQPLAN) [1093]

Knowledge of contract regulations and government contract vehicles, and ability to form contracts through source selection planning, identifying solicitation terms and conditions, and identifying and selecting techniques for determining price reasonableness. Also includes ability to recognize factors to be considered when evaluating and providing government financing, conducting price analyses, negotiating, identifying actions to resolve protests, and contract awarding.

1.2.2.2. Contract Formation   (CONFORMAT) [1094]

Knowledge of contract regulations and government contract vehicles, and ability to form contracts through source selection planning, identifying solicitation terms and conditions, and identifying and selecting techniques for determining price reasonableness. Also includes ability to recognize factors to be considered when evaluating and providing government financing, conducting price analyses, negotiating, identifying actions to resolve protests, and contract awarding.

1.2.2.3. Contract Management and Performance Assessment   (CONPERFORM) [1095]

Knowledge and capabilities associated with managing contracts and evaluating a contractor's performance, including identifying and evaluating commercial and noncommercial financing arrangements, determining the appropriate actions necessary to ensure customer satisfaction, identifying and selecting the appropriate course of action for resolving a contractor dispute, and identifying and implementing contract close-out procedures.

1.2.3. Cost Estimation and Analysis   (COSTEST) [121]

This competency refers to the knowledge, capabilities, and practices associated with the determination, estimation, and analysis of costs. It encompasses analytical techniques required to develop and assess estimates for hardware/software acquisition; design, integration and test, production, operations and support costs (e.g., life-cycle costs) of programs, projects, systems, and resources. Estimating and cost analysis methodologies used include engineering, parametric, grass roots, analogy, cost performance analysis, schedule analysis, and statistical risk analysis. Knowledge and skills required include Work Breakdown Structure (WBS) development, data collection, cost estimating relationship development and documentation, application of cost models, and evaluation of cost realism in proposals.

1.2.4. Financial Management   (FINMMT) [118]

Knowledge of how to apply financial management skills, principles and practices, generally accepted accounting principles (GAAP), and the standards, policies and practices related to Federal, Agency and Installation accounting and financial management to obtain, utilize, manage and account for resources in the workplace. Ability to use accounting related tools and techniques, perform financial data analysis, compile and/or perform transactions, review related outputs, and identify problems and prepare standard documentation. Ability to develop and implement strategies to capture, record, maintain and allocate organizational resources rationally and effectively.

1.2.5. Internal Control / Audit   (INTAUD) [120]

Knowledge of how to evaluate control systems for financial, administrative, program, and operational activities to provide reasonable assurances that obligations, costs and disbursements comply with applicable regulations and laws, that property is funded, and assets are safeguarded; and that revenues and expenditures applicable to operations are properly recorded and accounted for. Involves ability to conduct surveys, studies and other investigations for management operations or related processes to assess and report adequacy, validity and compliance/non-compliance to requirements. Ability to communicate derived audit assessment and recommend, establish, modify and/or implement internal controls to mitigate findings.

1.3. Institutional Operations & Support Competency Suite

1.3.1. Institutional Environmental Engineering & Management   (ENVENGMMT) [133]

Uses knowledge of environmental engineering, environmental law, chemistry, biology, geology and hydrogeology to maintain a proactive stance regarding environmental stewardship, including protection and restoration of environmental resources such as ground water, surface water, soils, sediments, air, and natural, cultural and historic resources. Plans and assesses compliance with Federal, State, and local statutory and regulatory requirements, Executive Orders, and directives. Implements proactive programs such as recycling, pollution prevention, affirmative procurement and energy management, and remediation activities under RCRA and CERCLA requirements.

1.3.1.1.   Institutional Environmental Planning/NEPA (ENVPLAN) [1088]

Uses knowledge of environmental engineering, environmental law, economics and the physical sciences to fully consider the possible environmental effects, along with technical, economic, and other factors, in the earliest planning of proposed NASA Programs, Projects, and related activities. Implements the requirements of the National Environmental Policy Act (NEPA) including developing and reviewing NEPA documentation including Environmental Assessments, Environmental Impact Statements, Findings of No Significant Impact, and Records of Decision. Coordinates public meetings to solicit input on major Agency actions.

1.3.1.2.   Institutional Environmental Remediation (ENVREMED) [1089]

Uses knowledge of environmental engineering, chemistry, biology, geology and hydrogeology to identify, investigate, and cleanup contaminated hazardous waste sites in compliance with Resource Conservation and Recovery Act (RCRA) and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requirements. Performs remediation contract management duties including evaluation of contractor performance and financial and schedule planning and tracking. Negotiates agreements with Federal, State, and local regulators. Manages the schedule of scientific/engineering, contractual, management, and informational documents, including preparation of Records of Decisions (RODs), administrative orders, and consent decrees. Performs necessary community relations activities.

1.3.2. Fire Protection Engineering   (FIREPROT) [143]

Knowledge, capabilities and practices associated fire prevention-related tools and their application to systems for minimizing the occurrence or effects of fire. Maintains comprehensive knowledge of applicable NFPA, OSHA, NASA, aerospace and/or prevention industry trends, standards and develops policies for fire prevention. Demonstrates a comprehensive knowledge of and contributes to resources available in the fire prevention community including NASA, DOD, academia, and industry. Capability to review and assess complex technical documents for their impact on fire prevention work. Maintain a comprehensive knowledge of Life Safety Systems. Capability to provide mitigation strategies for fire protection when requirements cannot be met..

1.3.3. Master Planning   (MASTERPLAN) [167]

Knowledge of strategic and long-term planning for operations, research or development activities at the Center level. Knowledge required to develop functional and overall Center requirements including fit of specific facility needs and requirements as well as workflow and long-term scheduling.   Includes knowledge required to coordinate and incorporate the necessary facilities and other building and infrastructure to satisfy all functional, institutional needs to meet mission requirements. Specialized knowledge of transportation modeling as well as broad aspects of community interface for emergency services and other requirements of large complex industrial installations.

1.3.4. Institutional Logistics, Supply and Transportation   (LOGSUPTRAN) [134]

Knowledge of principles, practices, equipment and tools in the areas of Logistics, Supply and Transportation. Understanding of how to manage and optimize equipment, supplies and transportation systems to provide an infrastructure that enables the agency to operate effectively. Includes management of specifications, acquisition, certification, storage, delivery, lifecycle support, distribution, and disposal of supplies, hardware, materials, equipment, and property (except real estate) and the operation and maintenance of transportation and other equipment used to move materials or passengers. Also includes management of inventories, including government property, equipment and materials provided to employees and contractors, so that the property is accurately accounted for, reported against and disposed of at the end of its useful life. Requires understanding of government regulations regarding property management and disposal, and related contracting terminology and requirements.

1.3.5. Security & Program Protection (SECURITY) [126]

Knowledge, capabilities and practices associated with providing security to protect facilities, personnel and programs. Ability to develop, implement and manage processes and programs involving law enforcement, counter-intelligence and counter-terrorism investigations, and security support programs including physical, information, personnel and industrial security.

1.3.5.1. Physical Security (SECPHYSCL) [1072]

Knowledge, capabilities and practices associated with the protection of property and individuals from threats or adversarial influences. Abilities deal primarily with assessing risk, conducting surveys and implementing physical counter-measures designed to protect personnel from potential threats; prevent unauthorized access to equipment, facilities, material, and documents; and safeguard against espionage, sabotage, damage, and theft.

1.3.5.2. Counterintelligence/Counterterrorism Analysis, Investigation and Liaison (SECOUNTER) [1073]

Knowledge, capabilities and practices associated with receipt, analysis, dissemination and investigation of information for the purpose of detecting, deterring and neutralizing acts involving espionage, intelligence activities, sabotage and/or terrorist activities conducted for or on behalf of foreign powers, organizations or persons.

1.3.5.3. Information Security (SECINFO) [1074]

Knowledge, capabilities and practices associated with the protection of national classified information and sensitive but unclassified (SBU) information including; classification, declassification, and protection of classified national defense information originated or controlled by Federal agencies in accordance with Executive Order 12958, April 17, 1995, "Classified National Security Information,"

1.3.5.4. National Security Systems (SECNATION) [1075]

Knowledge, capabilities and practices associated with researching and implementing national security systems used for transmitting national security information, including classified and sensitive unclassified information technology systems and programs involving secure voice, data, video, and facsimile to include ground-to-ground, space-to-space, and ground-to-space communications assets.

1.3.5.5. Personnel Security (SECPERSON) [1076]

Knowledge and ability to request background investigations appropriate to position sensitivity and to review and evaluate completed background investigations for the purpose of assessing loyalty, reliability, suitability, and trustworthiness of applicants, employees, and others to work for the U.S. Government, on U.S. Government contracts, and/or will have access to classified national security information and material.

1.3.5.6. Industrial Security (SECINDUST) [1077]

This competency refers to the knowledge and ability to perform personnel, physical, and information security functions related to contractors and contract facilities, in accordance with the National Industrial Security Program (NISP), established by Executive Order 12829; the National Industrial Security Program Operating Manual (NISPOM), NIPSOM Supplement and Executive Order 12958, "Classified National Security Information. Includes ensuring that private industry and colleges/universities, while performing on government contracts or conducting research and development, properly protect classified assets in their possession. Capabilities include conducting site security reviews and establishing criteria for contractors and subcontractors covering such matters as foreign ownership or influence; classification and clearance levels required for contract performance; product classification; and access to communication security, intelligence or international organization information.

1.3.6. Emergency Management (EMERGMMT) [151]

Knowledge, capabilities, and practices of Comprehensive Emergency Management are associated with an integrated approach to the management of emergency programs and activities for all four emergency phases (mitigation, preparedness, response, and recovery), for all types of emergencies and disasters (natural, man-made, and attack), and for all NASA sites and centers, to include special National Level requests. Applies expert knowledge of the National Incident Management System, the National Response Plan, and Homeland Security Presidential Directives and other federal policies to enable effective emergency programs at the national, state, or local level as appropriate. Ability to

lead, coordinate, manage and direct the development and implementation of NASA's and Federal emergency management policies, plans, and procedures for emergency response conditions, contingencies, continuity of operations, occupant emergency plans, and NASA's interagency support functions in a full spectrum of emergencies.   This competency includes the commitment to produce sound policy through requirements development that may affect lives, property, and operations in the event of unknown scenarios. Demonstrates the ability to: develop standards and specifications for new data analysis and data collection processes related to emergency preparedness; serve as an Aency, national level and industry-wide resource and has an established network to facilitate the acquisition of other resources and information; develop and/or modify safety procedures and requirements for related work and organization; maintain expert knowledge of applicable NASA, federal, aerospace and/or industry emergency preparedness trends, standards and policies; provide design concepts, risk management, trouble-shooting and trade-off analysis; technical expertise to represent Agency-wide, federal, industry and academic working groups, boards and panes; manage and provide comprehensive interpretation and equivalencies for all phases of emergency management; exhibit comprehensive knowledge of FEMA, OSHA and NASA standards pertaining to emergency management; represents agency in determining levels of coordination with intergovernmental departments, state and local agencies; evaluate agency exercise design criteria for emergency response; conduct risk assessments.

1.3.7. Occupational and Environmental Health   (OCCHEALTH) [130]

Knowledge, capabilities, and practice associated with NASA, Federal, and State OSHA health and safety regulations, policies and procedures used to develop and implement mishap and environmental health prevention practices and measures in all NASA work places. These knowledge areas include safety of personnel and equipment during launch vehicle processing, normal and industrial and laboratory operations, special high hazard tests and operations, aviation and space operations, use and handling of materials and chemicals, and design, construction, and use of facilities. Capabilities include ability to develop and analyze policy, manage, and assess the effectiveness of health programs and practices, which are designed to prevent injury to personnel and loss of NASA property in the industrial work environment, and promote the health and well being of employees.

1.3.7.1.   Occupational Medicine (OCCMED) [1066]

Professional skills and knowledge to apply occupational health related requirements to protect and maintain workers' physical and mental health. Knowledge to apply and initiate preventive health and wellness measures to reduce work-related illnesses and injuries. Knowledge and experience to manage implement and evaluate occupational medicine program areas. This includes clinical case management, health surveillance, and emergency medical response.

1.3.7.2.   Industrial Hygiene (OCCHYGIENE) [1067]

Professional knowledge and skills to develop and implement preventive measures regarding all work-related exposures, injuries, and illnesses. Knowledge to coordinate, implement, manage, and assess the impact and effectiveness of related programs, practices and policies across the Agency, designed to protect the health of employees. Knowledge to provide advice to Agency top management concerning the impact that new regulations and technologies will have on the health of employees. Knowledge to provide professional symposia, workshops, and coordinate the development of related training programs for Agency-wide application.

1.3.7.3.   Health Physics (OCCPHYSICS) [1068]

Knowledge of Federal and State Health Physics (ionizing and non-ionizing radiation) regulations, policies, and procedures, to develop and implement preventive measures regarding all work-related exposures, injuries and illnesses. Knowledge to develop, coordinate, implement, manage, and assess the effectiveness of related programs, practices and policies across the Agency, designed to protect the health of employees. Knowledge and skills to evaluate the application of new technologies to Agency related issues, and the impact of new laws and regulations and provides advice to Agency top management. Knowledge to provide professional symposia, workshops, and develop related training programs for Agency-wide application.

1.3.7.4.   Employee Assistance (OCCASSIST) [1069]

Professional knowledge and skills to improve the mental health and well being of employees.   Knowledge of regulations and programs to coordinate, implement, manage and assess the effectiveness of related employee assistance programs, practices and policies, including substance abuse prevention and treatment in support of drug-free Federal workplace program. Knowledge to implement programs and training for all mental health concerns for employees and their immediate families. This includes critical incident stress or other traumatic events in the workplace, promotion of an emotionally healthy workforce, and assessment of regulations that potentially impact the workplace.

1.3.8. Facilities Engineering and Management (FACENG) [112]

Knowledge of facilities engineering , facility evaluation, cost, schedules and formulation of performance requirements and alternative analysis/scenarios for key facilities. General knowledge of architectural, civil, mechanical and electrical engineering disciplines. Knowledge of project management and control including life-cycle costs, engineering economics, and project planning and evaluation including scope, cost and schedule and program controls including earned value management or other measure for facility project controls. Also requires knowledge of construction contracting and contractor oversight and contracts management.

1.3.8.1.   Facility Civil Engineering (FACIVENG) [1090]

Knowledge of building and foundation design and construction, concrete and steel design and construction as well as design and construction of roads, utilities, and other civil projects for aerospace facility programs. Requires understanding of energy management and sustainability standards for sustainable design. Also requires knowledge of construction contracting and contractor oversight and contracts management.

1.3.8.2.   Facility Mechanical Engineering (FACMECHENG) [1091]

Knowledge of planning, designing, developing, testing, or evaluating mechanical, electromechanical, pneumatic, hydraulic, fluid or structural equipment and systems for aerospace facility programs. May include specialization in Heating Ventalation and Air Conditioning (HVAC), piping and elevators. etc. Also requires knowledge of construction contracting and contractor oversight and contracts management.

1.3.8.3.   Facility Electrical Engineering (FACELECENG) [1092]

Knowledge of planning, designing, developing, testing, or evaluating electrical components, electrical installation and inspection for aerospace facility programs. Knowledge of electrical codes and standards, and testing of complex electrical or electronic systems including sources, loads, power management and distribution, communications and controls. Also requires knowledge of construction contracting and contractor oversight and contracts management.

1.3.8.4.   Construction Management (FACONSTMMT) [1096]

Knowledge of the materials, methods, systems, and the tools used to construct facilities and other real property infrastructure.

1.3.8.5.   Real Property Management (FACPROPRTY) [1097]

Knowledge of requirements and processes to manage real property including buildings, other infrastructure, land, and leases and other interests in property and real estate for industrial and aerospace operations.   Knowledge of real estate principles, practices and law as they apply to the management, leasing or acquisition of real estate. Knowledge of records management for financial accounting and value maintenance, including development of files and records to serve as legal documentation of ownership and material value. Knowledge of facility utilization

include space planning and tracking for institutional charges as well as for space management and utilization reporting at the agency as well as at the federal level.

1.3.8.6. Facilities Operations and Maintenance (FACOPSMAIN) [1098]

Knowledge of operation and maintenance of office, operations and/or research facilities, and associated systems and equipment. Includes but is not limited to: knowledge required to develop and manage a comprehensive program of facilities management services, such as test planning and development, development of operational plans and procedures, data acquisition and analysis, test scheduling, resource planning, development of facility capability enhancements, reliability centered maintenance, energy conservation, system health monitoring, minor facility modification and repair, etc., to operate, sustain and optimize facilities and equipment. Includes the ability to effectively integrate these services to be consistent with the strategies and program goals of the organization.

1.3.9. Institutional Aircraft Operations (AIROPS) [152]

Knowledge of aircraft operations, maintenance, acquisition, airworthiness and aviation safety principles for technologically complex aircraft programs and their associated systems and facilities. Knowledge of how to develop aircraft requirements and the associated costs and scheduling to satisfy functional and regulatory requirements. Ability to develop and manage a comprehensive aviation program to sustain and optimize institutional and research and development (R&D) requirements consistent with standards, codes and regulations. Effectively integrate these aircraft services to be consistent with the broader objectives, strategies, and program goals of the organization.

1.3.10. Research, Development or Flight Facility Planning (FACLTYPLAN) [168]

Knowledge of strategic and long-term planning for research, development or flight facilities and related equipment required to support operations for current and future program needs. Knowledge required to develop functional and facility requirements and the associated costs and scheduling.   Includes knowledge required to coordinate and incorporate the necessary architectural engineering to satisfy all functional, institutional and regulatory requirements. Specialized knowledge of engineering and technology competencies to address specific high energy/ high risk facility systems including but not limited to: high temperature systems, high pressure systems, cryogenic systems, exotic gases, control systems, data acquisition systems, energy transfer systems, laboratory workspace planning, communication infrastructure. Knowledge of project management and control including life-cycle costs, engineering economics, and project planning and evaluation including scope, cost and schedule and program controls including earned value management or other measure for project controls. Includes abilities to devise and implement policies and procedures regarding risk/hazard mitigation and safety assurance.

1.3.11. Workplace Safety (WORKSAFETY) [150]

Knowledge, capabilities, and practice associated with NASA, Federal (29 CFR 1960), and State OSHA health and safety regulations, policies and procedures used to develop and implement mishap prevention practices and measures in all NASA work places. These knowledge areas include safety of personnel and equipment during launch vehicle and payload processing, range operations, normal and industrial and laboratory operations, special high hazard tests and operations, develops explosives safety programs for pyrotechnics, and propellant operations, explosives and propellant citing, aviation and space operations, use and handling of exotic materials and chemicals, and design, construction, and use of facilities. Capabilities include ability to develop,assess and analyze workplace mishap prevention policy, manage, and assess the effectiveness of safety programs and practices, which are designed to prevent injury to personnel and loss of NASA property in all work environments on land, sea, air or space, and promote the safety of all employees. This function will also assure the proper investigation, recording, and corrective action documentation of all mishaps within the agency. At the National Level assures interagency coordination with all concerned departments and agencies concerned with safety and health policy development, program execution and evaluation.

1.4. Workforce Operations & Support Competency Suite

1.4.1. Diversity Management (DIVERSEMMT) [158]

Knowledge, capabilities and practices associated with the application of diversity management including developing, implementing, evaluating, and monitoring the Agency's Diversity Strategic Implementation Plan and related programs as well as internal diversity communications and external diversity relations, diverse employee network groups, diversity training initiatives, diversity councils, and mentoring initiatives. Works in partnership with the Center(s) leadership and Diversity Council(s) to optimize and support efforts to acquire and sustain a vital effective workforce, to capitalize on the strengths of a diverse workforce to better perform the Center's mission through teamwork and innovation, and to build an organizational climate in which employees respect, appreciate, and value individual differences as catalysts for creativity and productivity..

1.4.2. Human Capital Management (HUMCAPMMT) [128]

Apply knowledge and practices of the full range of personnel/human resource functions, such as classification, workforce planning & analysis, employee and labor relations, retirement, benefits, disciplinary actions, recruitment, selection, training, employee development, promotion regulations and procedures, compensation, and personnel information systems. Provide guidance and leadership in the motivation, performance measurement and overall management of the workforce including the design, delivery, implementation and evaluation of programs and processes. Includes understanding of organizational mission, strategy and business objectives as well as various rules, regulations and culture on people and their work.

1.4.2.1. Classification (HCMCLASS) [1115]

Knowledge of classification concepts, principles, and practices related to structuring organizations and positions and determining the appropriate pay system, occupational grouping, title, and pay level of positions..

1.4.2.2. Compensation (HCMCOMP) [1116]

Knowledge of compensation concepts, principles, and practices, including pay and leave administration and compensation flexibilities..

1.4.2.3. Employee Benefits (HCMEMPBENF) [1117]

Knowledge of HR concepts, principles, and practices related to retirement, insurance, injury compensation, and other employee benefits programs..

1.4.2.4. Employee Development (HCMEMPDEV) [1118]

Knowledge of employee development concepts, principles, and practices related to planning, evaluating,and administering training, organizational development, and career development initiatives.

1.4.2.5. Employee Relations (HCMEMPREL) [1119]

Knowledge of laws, rules, regulations, case law, principles, and practices related to employee conduct, performance, and dispute resolution.

1.4.2.6. Labor Relations (HCMLABOR) [1120]

Knowledge of laws, rules, regulations, case law, principles, and practices related to negotiating and administering labor agreements.

1.4.2.7.   Performance Management (HCMPERFMGT) [1121]

Knowledge of performance management concepts, principles, and practices related to planning, monitoring, rating,and rewarding employee performance.

1.4.2.8.   Recruitment/Placement (HCMRECRUIT) [1122]

Knowledge of HR concepts, principles,and practices related to identifying, attracting, and selecting individuals and placing them into positions to address changing organizational needs.

1.4.2.9.   Workforce Planning (HCMWORKPLN) [1123]

Knowledge of HR concepts, principles, and practices related to determining workload projections and current and future competency gaps to align human capital with organizational goals.

1.4.3. Equal Opportunity Management (EEOMMT) [129]

Knowledge, capabilities, and practices associated with formulating, planning, implementing, managing, tracking and evaluating equal employment opportunity initiatives and programs. Includes the ability to fully integrate EO into all aspects of NASA's mission as core values, to ensure a balanced and consistent implementation of statutory and administrative mandates such as maintaining an efficient and timely complaints processing program, an effective alternative dispute resolution program, and a comprehensive federally assisted and conducted non-discrimination program. Knowledge, capabilities and practices associated with creating an environment where all persons associated with NASA are treated fairly and without any form of unlawful discrimination in any agency program or activity. Includes the conceptualization, delivery and management of equal employment opportunity systems that meet NASA and Federal goals and objectives to eliminate discrimination and influence change in programs, practices and attitudes that are considered barriers to equal opportunity. Advisor/advocate role to agency officials to influence change and ensure compliance with relevant federal law, rules and regulations.

1.4.4. Professional Administrative Operations (PROFADMOPS) [115]

Knowledge, capabilities and practices associated with the support of administrative and management activities to facilitate organizational and mission goals and objectives. This competency requires knowledge of the appropriate rules, regulations, processes and associated systems within various enabling functions which may include human resources management, resource management, employee support services, documentation, procurement and financial management.

1.4.5. Para-Professional Business Operations (PARABUSOPS) [165]

The knowledge and capabilities associated with administrative, clerical and management support to a manager and/or organization to facilitate the mission, goals and customer satisfaction. This competency requires knowledge of policies, procedures and tools to implement operations within a business environment such as scheduling of meetings, office communication and document generation with the organization.

1.4.6. Student Trainee (STUDENT) [174]

This is a training and development competency for employees who are classified as Student Trainees. It is a generic competency that is intended to be used to help simplify the workforce planning process so tat students will be correctly identified and planned for during the workforce competency needs assesmement. Reference the Business Rules section in this document for further clarification.

1.4.6.1.   Technical Student Trainee (STUTECH) [1101]

This is a training and development competency for employees who are classified as Technical Student Trainees.

1.4.6.2.   Clerical Student Trainee (STUCLERICAL) [1102]

This is a training and development competency for employees who are classified as Clerical Student Trainees.

1.4.6.3.   Professional Administrative Student Trainee (STUPROFADM) [1103]

This is a training and development competency for employees who are classified as Professional Administrative Student Trainees.

2. Engineering & Technology Knowledge Domain

2.1. Engineering of Systems Competency Suite

2.1.1. Design and Development Engineering   (DESDEVENG) [8]

Knowledge, capabilities and practices associated with all aspects of the technical design and development process including the development of flight hardware, payloads, technology projects fabrication processes and techniques, concurrent engineering, production assessment, and process verification as applied to aerospace vehicles and systems used in atmospheric and space environments. Includes ability to create models and prototypes, particularly in a laboratory setting, based on research oriented plans and schematics and capability to design the system for safe and reliable development, integration and manufacturability.

2.1.1.1.   Structural Design and Development Engineering   (DDESTRUCT) [1028]

Knowledge, capability and practices associated with all aspects of the technical structural design and development by using and modifying advanced analytical and computational methods to design, develop, test and research the characteristics and performance of structures. Includes the development of structural math models for and comprehensive assessment of air, space and ground structures, the analysis of the models to determine structural response to multiple external and internal environmental conditions, and analysis of flight and test data for structural systems. Includes broad knowledge of structures disciplines including structural dynamics, structural mechanics, structural acoustics, mechanisms, electro-mechanical devices, aeroelasticity, impact, damage tolerance and structural life prediction. Also involves research into measurement, instrument and test systems to assess structural characteristics and risks, and ensure system integration.

2.1.1.2.   Electrical Design and Development Engineering   (DDEELEC) [1029]

Knowledge, capability and practices associated with all aspects of the technical electrical design and development process of electrical systems and components for air, space and ground systems and instruments. Includes knowledge of electrical integration such as electrical / electronic design requirements definition, subsystem and circuit analysis, test procedure development, and safety analysis. Includes broad knowledge EEE parts, electronic packaging design and tools, reliability and environmental effects, power generation, distribution, storage and conditioning systems.

2.1.1.3.   Propulsion Design and Development Engineering   (DDEPROP) [1030]

Knowledge, capabilities and practices associated with the detailed mechanical design of propulsion components, subsystems and systems. Includes expertise required for safe and reliable component and system design, development, and integration. Competency assumes a breadth of knowledge of many specialty areas such as

geometric dimensioning and tolerancing, cutting edge computer aided design and modeling tools, state of the art manufacturing and fabrication processes, specialty hardware and fasteners, bolted joint design, fits and interfaces, technical specifications, instructions and procedures, engine systems design, functional design, and design for optimization of component performance in relation to mission environments through testing. Also, depth in familiarization with system engineering tools, procedures, and documentation such as configuration management, the design review process, interface control documents, and interface requirements documents.

2.1.1.4.   Test Fixtures and GSE Design and Development Engineering   (DDETEST) [1031]

Knowledge of all aspects of the technical design and development process as applied to ground support equipment and special test fixtures relating to systems or subsystems including structural, electrical and propulsion components and technologies. Includes the definition or assessment of concepts and designs to assure adequate functional performance is achieved and system requirements are met and an assessment of the fabrication process and techniques, production assessment, and process verification of the hardware design. Includes knowledge and capability to create and evaluate subscale or full-scale models, test articles, or prototypes to assess the system or subsystem design, development, and integration meets the intended objectives.

2.1.2. Engineering and Science Support   (ENGSCISUP) [11]

Knowledge, capabilities and practices associated with supporting engineering and science functions. This support includes laboratory, modeling, manufacturing and analytical activities. Focus is on the abilities of an individual to visualize, plan and execute limited instructions from engineering, in the form of drawings/schematics, written or verbal direction, in order to produce a model, prototype or finished product. The technician's application of tools and apparatus, both physical and analytical, are a key element of this competency.

2.1.3. Integration Engineering   (INTEGENG) [9]

Knowledge and capability to integrate all elements into a functioning system or subsystem such as complex flight to flight and flight to ground and facilities systems. Includes knowledge and capabilities required for safe and reliable integration of different elements of a system, schedules, configurations and resources as well as the development of launch, mission, manifest, contigency and long-range plans and responses to externally-driven requirements.

2.1.3.1.   Structural Integration Engineering   (INTSTRUCT) [1032]

Knowledge of engineering; system engineering; manufacturing; testing; quality, reliability, and safety engineering; risk management; and resource, schedule, and programmatic requirements for the integration of structural systems, subsystems, and components that verify the completed products function, efficacy, and conformance to design requirements. This activity involves the long range planning, coordination, oversight, and integration of all structural systems, subsystems, and components in accordance with requirements and specifications, both external and internal.

2.1.3.2.   Materials Integration Engineering   (INTMATER) [1033]

Knowledge and capability to integrate all materials engineering elements and practices associated with research into the characteristics and performance of materials and the design, development and testing of those materials, into a functioning system or subsystem such as complex flight to flight and flight to ground and facilities systems. Includes knowledge and capabilities required for the development and application of math models and statistical analysis for assessment of material durability and response to environmental conditions and contaminants, required for safe and

reliable application and integration of materials engineering elements of a system, schedules, configurations and resources as well as the development of launch, mission, manifest, contigency and long-range plans and responses to externally-driven requirements.

2.1.3.3. Systems Integration Engineering (INTSYSTEMS) [1034]

The Systems Integration Engineer (SIE) is responsible for integration of all engineering products and resources necessary for product development and is the single technical interface between the engineering organization and the program/project office (PPO) for a specific product.   The SIE is responsible for vertical and horizontal integration of all engineering activities required for product delivery and is responsible to the PPO for cost and schedule performance under technical direction of a chief engineer.   The SIE tracks design decisions and requirements, maintains techncial baselines, manages interfaces, provides input to the PPO for risk management, tracks cost and schedule, tracks technical performance, verifies requirements are met and reviews and audits program engineering support activities.

2.1.3.4. Electrical Integration Engineering (INTELECT) [1035]

Knowledge and capability to integrate electrical components for air, space and ground systems and instruments into a functioning system or subsystems such as complex flight to flight, flight to ground, and facilities systems. Includes knowledge and capabilities required for safe and reliable integration of electrical systems, schedules, configurations, and electrical resources including power generation, control, and storage; controls and instrumentation; communications and data management; and electrical packaging, as well as the development of electrical and electronic systems impacts to launch, mission, manifest, contingency and long-range plans, and responses to externally-driven requirements.

2.1.3.5. Propulsion Integration Engineering (INTPROPEL) [1036]

Knowledge and capability to integrate propulsion elements into a functioning system or subsystem such as the integration of a propulsion system into a test stand, vehicle, or spacecraft or the integration of components (turbomachinery, main chambers, valves, etc.) into a propulsion system. Includes knowledge and capabilities required to understand the complex fluid and structural interactions of the various propulsion system or subsystem elements such as the interaction between the engine and main propulsion system or the interaction between a turbopump and an engine system. Includes the planning, design, development, and evaluation of the various components and subsystems that is necessary to insure proper function and compatibility within the propulsion systems.

2.1.4. Manufacturing Engineering (MANUFACT) [24]

Knowledge, capabilities and practices to perform concurrent engineering and producibility. Includes knowledge and ability to review design documentation, determine resource requirements for manufacturing activities, research and develop manufacturing processes, plan and manage hardware fabrication and assembly, develop and maintain manufacturing project schedules, and resolve manufacturing related problems.

2.1.5. Process Engineering (PROCESSENG) [114]

Knowledge, capabilities and practices associated with the development and implementation of safe, efficient, and effective processes to achieve performance excellence in Center operations, development, and enabling functions. This includes the identification, development, mapping, modeling, measuring, and analysis of processes that enable work activities, including their suppliers, inputs, outputs, customers, outcomes, and related decisions. Areas of specialization

include queuing theory, function analysis, work method/task analysis, human factors, stochastic methods, advanced statistical analysis methods, process improvement techniques, optimization algorithms, process simulation modeling (discrete and/or continuous), linear programming, and scheduling and capacity analysis systems.

2.1.6. Systems Engineering   (SYSTEMSENG) [7]

Knowledge, capabilities and practices associated with defining, developing, integrating and verifying an end-to-end new or existing system, with the objective of optimizing performance, safety and mission objectives. Includes knowledge required for safe and reliable system development/integration. Ability to perform feasibility assessments, provide functional analyses; develop and manage system performance and interface requirements to ensure the resulting system meets all technical objectives; perform systems analysis and trade studies, and oversee systems integration and verification. Includes knowledge of system engineering tools and procedures such as configuration management, integrated logistics management, risk management, and documents such as integrated schematics, interface control documents, and interface requirements documents for defining interconnection of system parts, documenting and managing system configurations and identifying all required interfaces, and mass properties for determining weight distributions. Assumes a breadth of knowledge of many specialty areas, and a detailed understanding of how the pieces fit together. Thorough knowledge of the NASA process of reviews, audits, and control gates to ensure all technical and programmatic requirements are being met in an organized fashion.

2.1.7. Test Engineering   (TESTENG) [10]

Knowledge of physics, engineering and manufacturing to test systems or subsystems under development for their functioning, efficacy and conformance to design requirements, or to test prototypes for feasibility. May involve ability to plan, conduct, and evaluate developmental, qualification, and acceptance testing in accordance with NASA, Military or Commercial Specifications of air, space and ground systems, components, piece parts, as well as integrated systems. Includes knowledge of environmental test techniques used to simulate loading conditions such as launch, reentry, orbit, and landing, including vibration, shock, acoustics, contamination, acceleration, electromagnetics, radiation, pressure, thermal, chemical, microgravity and solar vacuum, aerodynamics and temperature and humidity. Includes knowledge required for safe and reliable system development/integration.

2.1.7.1.   Structural Test Engineering   (TSTSTRUCT) [1037]

Knowledge of physics, engineering, and manufacturing to test structural systems, subsystems, and components that verify the functioning, efficacy, and conformance to deign requirements of these structures. This activity involves the planning, conduct, and evaluation of results for structural system development, qualification, or acceptance tests in accordance with NASA, military or commercial specifications. It includes the knowledge of structural test techniques to simulate loading conditions for structural systems experiencing launch, on-orbit, re-entry or landing environments and the associated response measurement methods to verify or correlate the structural system's analytical models. Test discipline skills associated with this competency include: vibration; acoustics; shock; static structural loads; and modal analysis.

2.1.7.2.   Materials Test Engineering   (TSTMATER) [1038]

Knowledge, capabilities and practices associated with materials testing and the behavior and performance characteristics of materials in their use environment. Included is the understanding of various test set ups, instrumentation, data acquistion, equipment and tools utilized for material qualification and certification for ground and aerospace flight systems.

2.1.7.3.   Thermal Test Engineering   (TSTTHERMO) [1039]

Knowledge of physics, engineering, thermal, and thermal vacuum to test systems or subsystems under development, qualification, or acceptance requirements for their functioning, efficacy and conformance to design requirements and performance, or to test prototypes for feasibility. May involve ability to plan, create test procedures, conduct, and evaluate developmental, qualification, acceptance, and flight test and checkout requirements in accordance with NASA, Military or Commercial Specifications of test facilities, space and ground systems, components, piece parts, as well as integrated systems. Includes knowledge of environmental test techniques used to simulate thermal and thermal vacuum conditions such as launch, reentry, orbit, and landing, including radiation, pressure, thermal, outgassing, microgravity and solar vacuum, aerodynamics and temperature and humidity. Includes knowledge required for safe and reliable system testing and development/integration.

2.1.7.4.   Electrical Test Engineering   (TSTELECT) [1040]

Knowledge of the principles of electrical engineering, and electronic manufacturing to test components, systems, or subsystems under development for their functioning, efficacy and conformance to design requirements, or to test prototypes for feasibility. May involve ability to plan, create test procedures, conduct, and evaluate developmental, qualification, acceptance, and flight test and checkout requirements testing in accordance with NASA, Military or Commercial Specifications of air, space and ground systems, components, piece parts, as well as integrated electronic systems or sub-systems. Includes knowledge of environmental test techniques used to verify workmanship and validate operations in a relevant environment, including vibration, shock, acoustics, electromagnetic interference and compatibility (EMI/EMC), depressurization and vacuum operation, and thermal cycling.

2.1.7.5.   Propulsion Test Engineering   (TSTPROPUL) [1041]

Knowledge, capabilities and practice associated with propulsion systems, subsystem, and/or component testing and cryogenic fluids as it relates to the functioning, efficacy and conformance to design requirements, or to test prototypes for feasibility or flight performance. Includes developing the procedures, methods, and techniques necessary to perform the test, to prepare, checkout, and assess the readiness of the test facility, and to ensure the safety of the systems or hardware. Includes full-scale or sub-scale testing of engine systems, subsystems, or components such as combustion chambers, nozzles, turbomachinery, ducts, valves, and pressurization systems. Includes knowledge of test techniques used to verify workmanship and validate operations in a relevant environment in accordance with NASA, Military or Commercial Specifications of air, space and ground systems, components, piece parts, as well as integrated propulsion systems or sub-systems.

2.2. Systems Analysis & Mission Planning Competency Suite

2.2.1. Advanced Mission Analysis   (ADVMIS) [89]

Knowledge, capabilities, and practices associated with the conception, development, and planning of advanced mission architectures and systems synthesizing science, commercial, military and exploration requirements and considering feasibility, performance, cost, risk, schedule, reliability/safety and environmental effects.

2.2.2. Aerospace Systems Concept Development & Technology Assessment   (ASCDTA) [90]

Knowledge, capabilities and practices associated with the development of aerospace vehicle and spacecraft concepts from a systems perspective to satisfy prescribed mission architectures and identify enabling technologies for performance, cost, risk and safety. Knowledge of conceptual design, sizing & synthesis of aerospace vehicles or spacecraft. Knowledge of elicitation from subject matter experts of the potential technology improvements from R&D projects in all the relevant aerospace disciplines.

2.2.3. Mission Analysis and Planning   (MAP) [1]

Knowledge and ability to analyze requirements of current and near-term missions. Manage integration of technical elements such as vehicle design, flight trajectories, and operational and ground-based infrastructure requirements in order to meet mission and programmatic objectives.

2.2.4. Mission Flight Design   (FLTDSG) [2]

Knowledge and ability to conduct computational analysis of air and space vehicle flight design for mission implementation, including sequencing, trajectory optimization, orbital mechanics, flight mechanics and celestial mechanics. Use flight design modeling and simulation tools that determine optimum trajectory solutions. Includes in-depth analysis of air borne and ground-based trajectory predictions, automated trajectory planning and modeling and trajectory negotiation and data exchange as well as optimization tools which take into account environmental and design constraints. Involves analysis of flight dispersion variables and navigation predict generation.

2.2.5. Simulation Systems   (SIMULATE) [175]

Knowledge, capabilities, and practices associated with real-time simulation which is a realistic representation of the physical system being studied (as opposed to pure mathematical analysis or standard computer analysis) and permits both quantitative and qualitative (human analysis) evaluation. A simulation system is usually characterized by a space or aviation flight deck/cockpit, interface hardware, computers, and flight crew, all of which are linked together in a closed loop system. In addition, flight crew can be trained for various operational concepts without using expensive vehicles.

- Require knowledge and experience in real-time concepts, computer system engineering and operations; simulator hardware engineering, operation, and maintenance; real-time simulation modeling analysis; and real-time software design, development, verification, and validation.

- Require knowledge and capabilities in simulator hardware engineering that includes design and implementation of a flight deck equiped with instrument panels, side stick/wheel column as vehicle controlling devices, visual scene for out-the-window view, heads-down display systems, and environmental sound effects.

- Require knowledge and capabilities in developing and operating a simulation driven by high speed, high performance computers for complex math model computation; specialized graphics computers, visual scence computers, and video distribution; high performance computer network; and special purpose software for real-time math modeling, graphics generation, system interfaces, communications, and networking.

2.3. Aeronautics Competency Suite

2.3.1. Acoustics   (ACOUSTICS) [103]

Knowledge, capabilities, and practices related to interior and exterior noise reduction and acoustic design for advanced aerospace systems, subsystems, and components to meet environmental requirements. Includes knowledge and application of experimental and computational aero and structural acoustics. Inherent in this competency is the capability to determine the influence of acoustic environment on ground observers and vehicle passengers alike, as well as to develop an understanding of its impact on vehicle structural responses, including sonic fatigue. Includes ability to conceive, plan, and implement appropriate experimental and flight test programs that are designed to understand and predict the acoustic environment and to validate advanced active and passive noise control concepts.
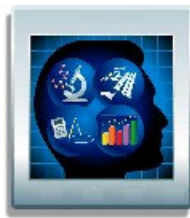
2.3.2. Aerodynamics   (AERODYN) [101]

Knowledge of the science of aerodynamics, with the ability to plan, conduct, interpret and correlate results of experimental investigations, analytical methods and numerical simulations with varying degree of fidelity such as computational fluid dynamics (CFD) analyses for the design of aerospace vehicles and components, which include commercial and military aircraft, space transportation systems and launch vehicles, and the prediction of their aerodynamic performance from subsonic to hypersonic Mach numbers, including incompressible flows, and over wide range of Reynolds numbers and flight conditions. Includes knowledge, capabilities and practices associated with fluid dynamics and flow physics modeling in specialized areas such as external and internal flows, analytical and CFD prediction methods, wind tunnel model and flight testing techniques, unsteady and high angle-of-attack flow phenomena, propulsion system-airframe integration, rotary wing aerodynamics, cavity flows, etc., for a realistic assessment and improvement of the vehicle aerodynamic performance.

2.3.3. Aeroelasticity   (AEROELA) [100]

Research knowledge, capabilities, and practices for investigating aeroelastic phenomena and complex steady and unsteady aerodynamic flow phenomena especially in the transonic speed range, for investigating, developing, and demonstrating novel concepts that prevent aeroelastic instabilities, alleviate adverse aeroelastic responses, reduce loads and vibrations, and exploit the aeroelastic characteristics of aerospace vehicles, for developing analytical methods that predict the aeroelastic and aeroservoelastic responses of aerospace vehicles, and for conducting unsteady aerodynamic, aeroelastic, and aeroservoelastic wind-tunnel tests.

2.3.4. Aerothermodynamics   (AEROTHM) [102]

Knowledge, capabilities, and practices related to aero/aerothermodynamic design for aerospace vehicles and components under various flight conditions including liftoff, ascent, stage separation and reentry. Ability to plan, conduct and interpret results of experimental investigations and analytical/computational fluid dynamics to derive aerothermal environments. Inherent within this competency is also the ability to determine the effects of propulsion system plumes on the vehicle/components performance and environment. Knowledge of high temperature gas physics including molecular and atomic internal energy structure, rate processes, and radiative emission characteristics.

2.3.5. Air Traffic Systems   (AIRTRAFFIC) [108]

Knowledge of Air Traffic Management elements, and their properties and interactions, such as air space and range systems, air traffic regulations, aircraft characteristics, airport structures and systems, and geographic and topographical patterns. Apply knowledge of these elements to the development of new systems and tools to improve the efficiency, effectiveness and capacity of the air traffic system, using advanced distributed modeling techniques to research and test concepts and prototypes.

2.3.6. Flight Dynamics   (FLTDYN) [98]

Knowledge, capabilities, and practices associated with research and technology in analytical, computational, and experimental methods to characterize the flight dynamics behaviors of aerospace vehicles.

2.3.7. Simulation/Flight Research Systems   (SIMFLTSYS) [110]

Knowledge capabilities and practices used to provide and integrate appropriate real-time hardware/software systems in support of piloted simulators and research aircraft that enable experiments in Flight Dynamics, Guidance/Navigation/Control, Crew Systems and Aviation Operations, Reliable Digital Systems and Electromagnetics.

2.4. Human and Biological Competency Suite

2.4.1. Aerospace Medicine   (AEROMED) [36]

Knowledge, capabilities, and credentials to engage, determine, and maintain and provide for the physical and behavioral health, and medical care of crew members, their families, and associated personnel during all mission phases (pre-flight, in-flight and post-flight) in the diverse environments of atmospheric and space flight missions.

2.4.1.1.   Medical Practice   (MDPRACTICE) [1070]

Knowledge and expertise of the multi-disciplinary practice of Aerospace Medicine taking into account the hostile, diverse environments of NASA aeronautic and space missions. Health maintenance and diagnosis and treatment of illness and injuries are the goals of medical practice. Knowledge and skills of physiology of mission environment, operational medicine, clinical practice, human systems interfaces, and astronaut selection and training.

2.4.1.2.   Behavioral Health   (MDBEHAVIOR) [1071]

Knowledge and expertise of psychology/psychiatry in aviation and operational settings to maintain health and performance of crewmembers and appropriate associated personnel during all mission phases. Knowledge and skills of clinical and operational psychiatry, clinical, aviation or organizational psychology, psychosocial psychology, behavioral health maintenance, human systems interfaces and astronaut selection and training.

2.4.2. Bioengineering   (BIOENG) [58]

Application of technologies to living systems including such areas as biomechanics, imaging, biomedical transducers, biofluids and sensors.

2.4.3. Biomedical Engineering   (BIOMEDENG) [35]

Knowledge of engineering, design, development, analysis and test of biomedical systems such as equipment and tools for maintaining crew psychological and physical health for long-duration missions in space. Involves knowledge of broad array of engineering disciplines, and biomedical research, human factors and space medicine findings and practices. Includes knowledge of operational impacts and sustaining engineering on the systems.

2.4.4. Biomimetics   (BIOMIMETIC) [59]

Knowledge and capability to research and further study natural processes which have potential to be deciphered, mimicked and adopted in technology applications based on biological systems such as environmental heat sensors, retinal or iris scans or face recognition technology. Also includes capabilities in the area of neural electric machine control.

2.4.5. Crew Systems and Aviation Operations   (CSAOPS) [97]

Knowledge, capabilities, and practices associated with research and technology in analytical and experimental methods for pilot/automation integration, crew station design, and aerospace vehicle operations concepts.

2.4.6. Extravehicular Activity Systems   (EAS) [38]

Knowledge of engineering, design, development, analysis and test of EVA systems. Requires knowledge and skills regarding the unique environment and constraints in sending a crewmember into space outside of a vehicle, and expertise in designing and developing spacesuits, tools, mechanisms, and operations that support such an activity. Includes knowledge of operational impacts and sustaining engineering on the system.

2.4.7. Environmental Control and Life Support Systems   (ECLSS) [37]

Knowledge, capabilities and practices associated with environmental control and/or life support systems used to protect life in dangerous or insupportive environments for flight or ground operations, including related instrumentation, controls, data acquisition, pneumatics and mechanisms. May include knowledge and capabilities needed for development of advanced and/or regenerative life support, such as how to apply plant physiology and pathology, microbial ecology, molecular biology, biological engineering, chemistry, chemical engineering and landscape ecology to development of advanced, regenerative life support such as air and water recycling, solid waste resource recovery, food sources and thermal environmental control.

2.4.8. Environmental Factors   (ENVFACT) [39]

Knowledge of practices associated with research of and applying research to spacecraft and space-based environments and the environmental effects on humans and other organisms with specific emphasis on barophysiology, microbiology and toxicology and radiation. Knowledge of physical and chemical sciences, including heat and mass transfer, acoustics, radiation, thermodynamics, fluid mechanics, and chemical, biological, and metabolic processes. Ability to integrate and apply this understanding to develop systems and technology to enable humans to live and work safely and effectively in space.

2.4.9. Fundamental Human Factors Research   (HUMFACTRES) [40]

Knowledge of human engineering research methods (e.g. literature search, experiment, operational analysis, observation, survey, protection of research subjects) and activities (e.g., experimental design, planning data collection, data analysis, statistics, and documentation. Knowledge of the effects of environmental, individual, cognitive and organizational factors on the behavior and performance of humans, as well as the associated underlying physiological, psychological and social/organizational drivers that influence human behavior. Includes knowledge of a variety of psychophysical areas such as, but not limited to, biomechanics, perception, cognition, sensory-motor control, communication, decision-making, and teamwork and human-automation interaction. Ability to apply theories, experimentation, analysis and modeling to increase fundamental knowledge about human cognition and performance. Ability to develop human factors principles and guidelines which could be used toward designing technology for human performance in complex aerospace operational environments to reduce errors and increase productivity.

2.4.9.1. Biomechanics and Ergonomics Fundamental Research (HFRBIOMECH) [1005]
TBD

2.4.9.2.   Habitability and Environmental Psychology Fundamental Research (HFRHABIT) [1006]

TBD

2.4.9.3.   Perception and Psychophysics Fundamental Research (HFRPERCEPT) [1007]

TBD (includes vision, audition, haptics, vestibular, multimodal)

2.4.9.4.   Psychophysiology Fundamental Research (HFRPSYPHY) [1008]

TBD (includes memory, attention, task processing, etc.)

2.4.9.5.   Fatigue, Alertness, Circadian Rhythms Fundamental Research (HFRATIGUE) [1009]

TBD

2.4.9.6.   Cognitive Science Fundamental Research (HFRCOG) [1010]

TBD (includes memory, attention, task processing, etc.)

2.4.9.7.   Communication and Knowledge Management Fundamental Research (HFRCOMM) [1011]

TBD (includes interpersonal communication, technology-mediated communication, procedures, documentation)

2.4.9.8.   Decision Making and Risk Management Fundamental Research (HFRDECISMK) [1012]

TBD

2.4.9.9.   Organizational Science Fundamental Research (HFRORG) [1013]

TBD

2.4.9.10.   Human-Machine Interaction Fundamental Research (HFRHUMMACH) [1014]

TBD (includes human-computer interaction and human-automation interaction) (includes human-computer interaction and human-automation interaction)

2.4.9.11.   Manual Control Fundamental Research (HFRMANCNTL) [1015]

TBD

2.4.9.12.   Supervisory Control Fundamental Research (HFRSUPCNTL) [1016]

TBD (includes single human operator supervisory control and distributed [multi-agent] supervisory control)

2.4.9.13.   Training and Adaptation Fundamental Research (HFRTRNG) [1017]

TBD (includes basic research on perceptual and behavioral adaptation, learning, memory, etc.)

2.4.9.14.   Human Performance Fundamental Research (HFRHUMPERF) [1018]

TBD (includes basic research on human error and error countermeasures)

2.4.10. Human Factors Engineering   (HUMFACTENG) [41]

Knowledge and capabilities to apply human factors engineering principles, standards, design guides, regulations, and advisory material to the .design, test, evaluation, operation, and maintenance of systems and processes. Knowledge of the physical and psychological processes, capabilities, skill levels, and limitations of humans, such as the science and practical application of experimental psychology, cognitive psychology, human reliability, anthropometrics, biomechanics, and psychophysiology. Knowledge of hardware and software human-interface design principles, modalities (e.g. physical, visual, auditory, verbal), methods (e.g. field studies, analysis, modeling, prototyping, laboratory experiments, simulations, mockups, database reviews) and tools. The ability to define and analyze human engineering requirements, formulate human performance criteria, develop guidelines, develop system concepts, designs, and prototypes; evaluate human-centered technologies, and develop training curricula for application to processes and systems.

2.4.10.1.   Biomechanical Engineering, Technology, Standards   (HFEBIOMECH) [1019]
TBD

2.4.10.2.   Ergonomics Engineering, Technology, and Standards   (HFEERGO) [1020]
TBD (including lighting, noise, vibration, physical ergonomics of hand tools, manual materials handling, etc.)

2.4.10.3.   Space Human Factors Engineering, Technology, and Standards   (HFESPACE) [1021]
TBD (focus on humans in micro-gravity, radiation environments)

2.4.10.4.   Habitability Engineering, Technology, and Standards   (HFEHABIT) [1022]
TBD

2.4.10.5.   Perceptual Technologies and Standards   (HFEPERCEPT) [1023]
TBD (includes visual display design, image and video compression, display composition and layout, icon design and font selection, auditory displays, multimodal environments)

2.4.10.6.   Cognitive Technologies   (HFECOG) [1024]
TBD (includes augmented cognition devices, decision support technologies, intelligent assistant systems)

2.4.10.7.   Human-Automation System Design   (HFEHUMAUTO) [1025]
TBD (includes Distributed Supervisory Control Design; fFunction Allocation; Mixed-Initiative Decision Making, Planning and Operations; Distributed Human-Machine Systems)

2.4.10.8.   Training Technologies   (HFETRNG) [1026]
TBD (includes computer-based training systems, intelligent tutoring systems, handbooks, documentation)

2.4.10.9.   Human Reliability and Human Error Analysis   (HFEHUMERR) [1027]
TBD

2.5. Chemical Competency Suite

2.5.1.   Chemistry/ Chemical Engineering   (CHEMENG) [25]

Knowledge, capabilities and practices associated with Chemistry and Chemical Engineering as applied to aerospace systems for ground and flight application, particularly for use in sensors, material sciences, propulsion, environmental,

ecological, biological or laboratory processes. This includes an understanding of organic, inorganic, analytical and physical chemistry and their application to a wide variety of research, development, failure analysis, and operational systems or topics and/or principles and practices of chemical engineering.

2.5.2. Pyrotechnics   (PYROTECH) [18]

Knowledge of the composition, nature, applications and handling of devices or assemblies containing or operated by propellants or explosives. Involves design and development of such systems for aerospace applications, as well as study of the safe operation and maintenance of the materials and systems. Includes knowledge of fluid and mechanics, thermodynamics, materials, chemistry and physics, structures, mechanical drawings, manufacturing processes and explosive material properties.

2.6. Computer Science & Information Technology Competency Suite

2.6.1. Computer Systems and Engineering   (COMPSYSENG) [80]

Knowledge of the design and development of computers and/or robots. Involves design of hardware, software, networks and processes to solve technical problems such as analyzing flight systems and aerospace data. Utilizes advanced technologies such as virtual reality, artificial intelligence, and automation. Includes knowledge of computer programming, electronics, mathematical models, and neural and/or other networking systems.

2.6.2. Data Systems and Technology   (DATSYS) [161]

Knowledge of the principles, procedures, and tools of data management, such as modeling techniques, data backup, data recovery, data dictionaries, data warehousing, data mining, data disposal, and data standardization processes.

2.6.2.1. Database Management Systems   (DATDBMMT) [1080]

Knowledge of the uses of database management systems and software to control the organization, storage, retrieval, security, and integrity of data. This could include the knowledge of the principles, methods, and tools for automating, developing, implementing, or administering database systems.

2.6.2.2. Large Scale Data Systems   (DATLARGE) [1099]

Knowledge of design, development and implementation of large-scale scientific data storage, access, retrieval and mining systems or techniques. Includes ability to transfer research algorithms into processing code that produces scientific data products for the science community. Includes knowledge of image methods and procedures for automated feature extraction from large data sets.

2.6.2.3. Data Visualization   (DATVISUAL) [1100]

Knowledge capabilities and practices associated with extracting information and knowledge from extremely large data sets through interactions with visualization systems. Capabilities include developing and using advanced data visualization systems for data mining, pattern recognition and feature extraction for application to earth and space science data sets, as well as large engineering data sets for aviation and space systems. Also involves knowledge of state-of-the art modeling and simulation techniques and hardware for interpreting data and translating the data into animated images for use in scientific and education contexts. Includes understanding of computer science, digital

animation three dimensional modeling, video generation and other data representation techniques. Also involves aesthetic skills in creating renditions of data with the power to communicate meaning.

2.6.3. Intelligent/Adaptive Systems   (IASYS) [85]

Knowledge of research and development techniques involving autonomous reasoning, human-centered computing and intelligent systems for data understanding towards mission requirements. Possesses knowledge of the practices associated with creating advanced intelligent, self-monitoring and adaptive computer science systems for use in development of aerospace vehicles (including unmanned systems), enhancement of aerospace flight safety and efficiency, and understanding of scientific data. Includes knowledge of modeling and simulation, techniques of artificial intelligence, virtual reality, automated software engineering, and collaborative and assistant systems, as well as understanding of vehicle health management.

2.6.4. Network Systems and Technology   (NETSYS) [81]

Knowledge of how to research and implement high-speed wide area networks, including technology development to allow very advanced networks to allow data, audio and video communication. This includes electrical, optical and wireless transmission, telemetry and modeling, simulation of communication systems, and emulation of flight systems, sensors and data acquisition systems to function in an optimal fashion for distributed science and engineering applications. Involves technical skills used in the development and application of computer networks and Internet technology, including switching/routing technology, network architecture, and network security.

2.6.5. Neural Networks & Systems   (NEUNETSYS) [84]

Knowledge, capabilities, and practices of synthesizing practical implementations of artificial neural networks for application to NASA missions, programs, and projects. This includes such applications as machine learning algorithms and pattern recognition systems for intelligent flight control systems, complex spacecraft docking capabilities, and instrument control mechanisms.

2.6.6. Robotics   (ROBOTICS) [79]

Knowledge of engineering, design, development, analysis and testing of robotic and robotic/human systems, including telerobotics. Includes knowledge of operational impacts and sustaining engineering on the system.

2.6.7. Software Engineering   (SWENG) [82]

Knowledge and ability to apply systematic, disciplines and quantifiable approaches to the acquisition and development of software systems for spaceflight, ground support, airborne and facility applications. Development and management of simulations, tools and integrated software development environments for the design, development, verification, testing, manufacture, operation and maintenance of such systems. Specialized knowledge to predict, evaluate and manage critical performance attributes of software-intense systems such as real-time response and embedded hardware-driven resource limits. Includes knowledge of high-performance computing, graphical user interfaces, networking, data integrity and security.

2.6.8. Imaging Analysis   (IMAGING) [166]

This competency referes to the knowledge and capabilities associated with the analysis of all imaging media to include film, motion picture and video in both visible and non-visible spectra. Includes using digital imagery manipulation techniques such as frame averaging, motion stabilization, point tracking, etc. to obtain specific data from the images such as object size, orientation, trajectory, and velocity. Requires detailed understanding of the cameras and photographic and digital processes used to obtain the imagery. The analysis supports vehicle preparation, launch, on orbit, in-flight, landing, terrestrial, extratrestrial and planetary study as well as other areas of imaging. This competency supports exploration, research and operations from basic scientific knowledge through flight safety.

2.7. Electrical & Electronic Competency Suite

2.7.1. Avionics   (AVIONICS) [21]

Knowledge of research and engineering of real-time analog and/or digital electronic avionics systems that use data acquired from sensors and instruments and processes it to determine status of systems for aircraft and spacecraft for such purposes as flight control, flight path management and vehicle health monitoring. Includes knowledge of design and development of computational hardware and software networks and interfaces, electrical integration, power distribution and electrical systems engineering.

2.7.2. Communication Networks & Engineering   (COMNETENG) [60]

Knowledge and practices associated with researching and developing air and space communications architectures and networks to meet mission and system requirements, and to research new technology for improving air traffic management and communication between satellites, flightcraft, spacecraft and ground. Includes knowledge of communication systems electronics engineering for sending and receiving signals with different networks, including wireless, digital and radio frequency bandwidths. May involve ability to make effective, efficient, and prudent use of the radio spectrum in the best interest of the Nation, with care to conserve it for uses where other means of communication are not available or feasible.

2.7.3. Electro-Mechanical Systems   (ELMECHSY) [15]

Knowledge of and ability to design, develop, test, integrate and evaluate electro-mechanical systems such as; gimbals, cryogenic mechanisms, smart structures, and magnetic bearings, solar array drive systems, choppers, shutters, scanning, and focusing mechanisms. Has capability to perform the complete engineering lifecycle on systems for the drive, sensing, and control of precision flight instruments, and spacecraft subsystems.

2.7.4. Electrical and Electronic Systems   (ELSYS) [13]

Knowledge of engineering design and analysis, development and research of electrical systems and components for air, space and ground systems and instruments. Includes knowledge of electrical integration (cable design/development/testing) such as electrical / electronic design requirements definition, subsystem and circuit analysis, test procedure development, and safety analysis. Includes knowledge of analog and digital electrical systems engineering, EEE parts, electronic packaging design and tools, reliability and environmental effects, power generation, distribution, storage and conditioning systems. Knowledge of thermal analysis of printed circuit boards and use to analyze data to optimize design of flight electronics.

2.7.4.1. Instrumentation Systems   (ELINSTR) [1042]

Knowledge, capabilities, and practices related to the design, development, characterization, and application of measurement and instrumentation systems used on space vehicles, flight payloads, experiments, ground test equipment, and test facilities. Ability to select and test appropriate measurement sensors for the various applications

and integrate these sensors into larger subsystems. Includes knowledge of, and capability to perform, research and development of new, advanced and unique measuring sensors for both flight and ground instrumentation systems in the areas of temperature, pressure, vacuum, vibration, position, displacement, acceleration, mass spectroscopy, heat flux, flow, optical spectrometry and strain.

2.7.4.2.   EEE Parts   (ELEEEPART) [1043]

Knowledge, capabilities, and practices associated with EEE Parts requirements, selection, analysis, and verification for space flight and ground support hardware.

2.7.4.3.   Parts & Packaging   (ELPARTSPKG) [1044]

Knowledge, capabilities, and practices associated with electro-mechanical design including printed circuit (pc) layout, design of mechanical housings (black boxes), thermal analysis of pc boards and black boxes, and processes involved in the manufacturing/assembly of this hardware.

2.7.4.4.   Electrical Circuits Engineering   (ELCIRCUITS) [1045]

Knowledge of, and capability to perform, engineering design and analysis, development and research of electrical circuits components, subsystems, and systems for air, space and ground systems and instruments. Includes knowledge of electrical cable design, development, and testing; electrical power distribution requirements and design; electrical packaging integration; subsystem and circuit analysis; test procedure development and safety analysis; reliability and environmental effects; and knowledge of thermal analysis of printed circuit boards and subsequent use of thermal data to optimize flight electronics design.

2.7.5. Flight and Ground Data Systems   (FLTGNDSYS) [19]

Knowledge of controlling and monitoring systems for aerospace vehicles, payload flight systems and related ground equipment. Knowledge of processing techniques and requirements for housekeeping, health and status, operational and science data for spacecraft and science instruments. Includes knowledge of data acquisition, storage, distribution systems, as well as data analysis and troubleshooting techniques; special purpose analog/digital data handling and unique interface applications software. Assumes broad understanding of IT, electronics and communications disciplines and an ability to integrate the pieces together to optimize the design, integration and test of flight and ground hardware and software

2.7.6. Control Systems, Guidance & Navigation   (GNC) [22]

Knowledge of and ability to develop analytical, computational, and experimental methods for control/guidance algorithms, and apply research to develop requirements for control and instrumentation systems; establish component and systems; and use analytical modeling and simulation tools that determine control dynamic solutions. Knowledge of research and engineering of integrated aerospace vehicle systems for the guidance, navigation, and control and health management of flight vehicles in the atmosphere and space. Includes knowledge of sensors and avionics, flight dynamics, mathematical modeling, experimental methods and a broad array of engineering disciplines.

2.7.6.1.   Spacecraft & Stabilization Control Design and Analysis   (GNCSPACE) [1046]

Knowledge of and ability to conduct research and develop analytical, computational, and experimental methods for control algorithm and control mechnism design and development for space vehicles, space systems and subsystems. Appliction of research and or trade studies to develop requirements for control mechanisms, sensors and instrumentation systems; establish functional, performance, design, analysis, test, integration and verification requirements for in-space control systems and precision pointing and stabilization systems, subsystems, control mechanisms and components. Competency includes the use analytical modeling and simulation tools that determine control system solutions, along with the knowledge of research and engineering of integrated space vehicle systems

for spacecraft control and health management of flight vehicles in diverse space environments. Includes knowledge of sensors, avionics, actuation and control mechanisms, large space structure dynamics, mathematical modeling, interplanetary environmental models, experimental methods and a broad array of engineering disciplines.

2.7.6.2.   Vehicle Control Design and Analysis   (GNCVEHCNTL) [1047]

Knowledge of and ability to research and develop analytical, computational, and experimental methods for control algorithm and control mechnism design and development for launch vehicles, space vehicles, and space systems and subsystems. Apply research to develop requirements for control mechanisms, sensors and instrumentation systems; establish functional, performance, design, analysis, test, integration and verification requirements for vehicle control systems, subsystems, control mechanisms and components; and use analytical modeling and simulation tools that determine control system solutions. Knowledge of research and engineering of integrated aerospace vehicle systems for vehicle control and health management of flight vehicles in the atmosphere and space. Includes knowledge of sensors, avionics, actuation and control mechanisms, flight dynamics, mathematical modeling, experimental methods and a broad array of engineering disciplines.

2.7.6.3.   Guidance Design and Analysis   (GNCGUIDE) [1048]

Design of guidance algorithms that command vehicle attitude angles and throttle settings (if applicable) for taking a vehicle from the current state to the desired final state in an optimal fashion within constraints. Includes all flight phases. Implementation of guidance algorithms in simulation. Support of vehicle design analysis through guided simulations including aborts and dispersions. Support of verification through demonstration that guidance integrates with the other subsystems to meet overall requirements. Detailed definition of guidance algorithms and support of software development and testing.

2.7.6.4.   Navigation System Design and Analysis   (GNCNAVSYS) [1049]

Knowledge of and ability to employ navigation hardware including Inertial Measurement Unit's (IMU: gyro and accelerometers), Global Position Satellite receivers, star trackers, sun sensors, etc. Knowledge of and skill in using Kalman filtering and other software techniques to merge data from different sources to obtain an accurate and optimum navigation solution. Skill in using the output navigation solution for orbit determination.

2.7.6.5.   Control Components   (GNCCTLCOM) [1110]

Knowledge of and ability to perform research, design, development, test and evaluation of inertial, celestial, magnetic and electro-optical sensors; momentum control actuators, precision gimbal systems, and precision mirror actuators; and linear and rotational magnetic and piezo-electric actuators for guidance, navigation and control systems; pointing and attitude control systems; and large space structures control. Ability to select and test appropriate sensors and actuators for the various applications and integrate them into larger subsystems. Includes knowledge of control circuitry, control theory, experimental methods, statistical analysis and application and mathematical modeling..

2.7.6.6.   Control Electronics   (GNCCTLELE) [1111]

Knowledge of and ability to employ navigation hardware including Inertial Measurement Unit's (IMU: gyro and accelerometers), Global Position Satellite receivers, star trackers, sun sensors, etc. Knowledge of and skill in using Kalman filtering and other software techniques to merge data from different sources to obtain an accurate and optimum navigation solution. Skill in using the output navigation solution for orbit determination.

2.7.7. Micro-Electromechanical Systems   (MICROELMEC) [16]

Knowledge, capabilities and practices associated with the research, design, development, test, evaluation, application and manufacture of MEMS technologies, including microfabrication, microsystem design and integration, modeling, and packaging.

2.7.8. Metrology and Calibration Competency   (METROLOGY) [160]

This competency refers to the knowledge, capabilities and responsibilities associated with the NASA Metrology and Calibration Program. It requires an understanding of the science of measurement and the comparing of a standard of known accuracy with a unit of test and measuring equipment (TME) for the purpose of detecting, correlating, reporting, or eliminating by adjustment any deviation in the accuracy of the unit being compared. It requires application of traceability principles and uncertainty analyses in relating those measurements to National standards, intrinsic standards, derived standards, or acceptable measurement systems through an unbroken chain of comparisons. This competency also includes understanding calibration laboratory requirements, their origin and purpose, application to contracts, use in auditing and surveillance, implementation in management and quality systems, and the impact of deficiencies, such as, out-of-tolerance TME.

2.7.9. Wireless Communications and Telemetry (WIRELESS) [159]

Knowledge, capabilities and practices associated with the design, analysis, development and/or test of microwave, RF electronic/Electromagnetic systems, particularly for use in flight vehicles, payloads or associated ground support equipment processes. Includes devices utilizing advanced technology for instrument (including data system) and communications (including telemetry) applications. Includes knowledge and capability in one or more of the following areas; RADAR, antenna systems for general electromagnetic components, communications systems for space, suborbital, aircraft, and ground applications, instrument systems (both active and passive), transmitting and receiving systems, transmission lines, electromagnetic propagation, data interleaving systems, navigational aids, atmospheric effects, multipath, scattering, Electromagnetic Interference, Compatibility and Effects (EMI/EMC/EME), modulation techniques, spectrum analysis, and non-ionizing radiation safety.`

2.7.10. Electromagnetics   (ELMAG) [12]

Knowledge, capabilities, and practices associated with research and technology in analytical, computational, and experimental methods to quantify and control complex electromagnetics phenomena to address issues such as electromagnetic interference, electromagnetic compatibility, electrostatic discharge, and advanced integral/conformal antennas. Also includes engineering design of systems and how they will react given electromagnetic fields, compatibility, interference and discharge.

2.8. Power & Propulsion Competency Suite

2.8.1. Advanced In-Space Propulsion   (ADVPRO) [72]

Research, development, design, testing and evaluation of propulsion technologies, such as nuclear propulsion, and space power generation systems to dramatically improve every aspect of in-space propulsion. Specialty knowledge in specific technologies such as nuclear propulsion, high powered electrical, solar voltaic, fuel cells, solar dynamic, and propellantless propulsion such as electrodynamic tethers and beamed energy.

2.8.1.1.   Advanced Chemical & Thermal Prop   (APCHEM) [1052]

Research, development, design, testing and evaluation of propulsion system technologies which seek to increase the performance rockets in the space environment through novel means such as more energetic chemical propellants, ultralightweight propellant storage and management subsytems, high temperature system operation, heat addition to propellant by insolation concentration, etc.

2.8.1.2.   Electric Propulsion (APELEC)   [1050]

Research, development, design, testing and evaluation of in-space electric propulsion system technologies, comprising power, power conditioning, propellant storage and management, and thrusters. Specialty knowledge in the three categories of electric propulsion thruster devices: electrothermal, electromagnetic and electrostatic.

2.8.1.3.   Propellantless Propulsion(APNOPROP) [1051]

Research, development, design, testing and evaluation of in-space propulsion systems which use technologies other than discharge of a propellant to gain motive force (i.e., non-rocket propulsion). Specialty knowledge in one or more categories of propellantless propulsion devices including solar sails, momentum exchange – electrodynamic reboost tethers, aerocapture, etc.

2.8.2. Airbreathing Propulsion   (AIRPRO) [69]

Knowledge of technologies and concepts for airbreathing propelled vehicles in order to enhance the safety of operations, reduce lifecycle costs, contribute to reduced costs of air travel and access to space, and reduce carbon dioxide emissions. Includes knowledge of various engine cycles, flight conditions, efficient mixing and combustion, various materials, and reliable design tools for aerodynamic and propulsion system design and performance prediction, as well as application of combined cycle systems to advanced propulsion techniques.

2.8.3. Combustion Science   (BOOMSCI) [74]

Employs knowledge, capabilities and practices of study of the science of burning and burning processes, including reaction kinetics and fuels, particularly related to heat transfer, combustion and fluid flow processes by which chemical energy is converted to propulsive power. Utilizes ground based or microgravity experiments to increase basic knowledge of combustion processes

2.8.4. Hypersonic Airbreathing Propulsion   (HAIRPRO) [70]

Knowledge of research and testing activities associated with hypersonic airbreathing propulsion flowpath and its integration with the vehicle concepts. Includes knowledge of the physics of high speed fuel-air mixing and combustion. Ability to plan, conduct, and interpret results of experimental and computational investigations to derive engine performance. Inherent within this competency is also the ability to design and develop engine components (inlet, combustor, and nozzle) and their interaction.

2.8.5. Hypergolic Systems   (HYPERSYS) [71]

Knowledge, capabilities and practices associated with hypergolic propellants and propulsion systems. This includes handling characteristics, material properties, system safety, and system unique requirements for the safe and effective test, implementation, and operation of hypergolic systems for research, development, design, analysis, testing and/or evaluation.

2.8.6. Nuclear Engineering /Propulsion   (NUCLEARENG) [138]

Knowledge of scientific and engineering principles associated with the safe design and operations of terrestrial and non-terrestrial nuclear reactor systems and radioisotope decay power systems. Knowledge and practice of neutron fission and

decay of nuclear material, radioactivity determination/calculation/shielding due to fission and decay of nuclear materials, thermodynamics, nuclear/quantum physics, materials science, operations and control principles of nuclear reactors, simulation of reactor operations, health-physics effects of reactor radioactivity on humans, and probabilistic risk assessment. Ability to develop design concepts for potential nuclear propulsion systems, evaluating proposed designs and doing tradeoffs to determine which concepts can be incorporated into future space missions.

2.8.7. Propulsion Systems & Testing   (PROSYS) [68]

Knowledge of conceptual aeropropulsion and aviation systems analysis and testing to assess the benefits of aeropropulsion systems, subsystems and components over all flight regimes from general aviation through space access. Knowledge of the integration of component technologies into conceptual systems. Includes research, design, testing, and evaluation of components systems such as combustors, inlets, nozzles, and turbomachinery, emissions, engine materials and structures, propulsion controls, and propulsion airframe integration. Knowledge of advanced, distributed instrumentation for acquiring improved information in a hostile engine environment. Experience in advanced methods for safe and affordable rocket propellant aeropropulsion systems testing.

2.8.8. Power - Energy Storage   (PWRENG) [76]

Knowledge, capabilities, and practices associated with the design, development, test, and evaluation of battery, flywheel, fuel cell, membrane technology and other electrical power storage components and systems.

2.8.9. Power Generation - Photovoltaics   (PWRPHO) [77]

Knowledge, capabilities, and practices associated with the design, development, test and evaluation of photovoltaic power generation systems, including electric actuation and solar cell/array systems.

2.8.10. Power Systems   (PWRSYS) [75]

Applies knowledge and capabilities involved in the design, development, test, and evaluation of hardware for power generation, storage, conditioning and distribution for all vehicles, spacecraft, and experiments. Inherent within this is a broad knowledge of power sources and technologies and the ability to develop power architectures and integrate all elements into networked systems tailored to their specific environments. Also includes development, test and evaluation of the impact of environments and material on power systems.

2.8.11. Power Generation - Thermal Systems   (PWRTHM) [78]

Design development, test, and evaluation of dynamic power systems including thermal and solar dynamic systems.

2.8.12. Rocket Propulsion   (ROCKETPRO) [73]

Knowledge of research and testing activities associated with liquid and solid rocket propulsion. Includes knowledge of combustion devices, cryogenic tanks, propellant feedlines, tank pressurization systems, engine systems, and propulsion system subcomponents such as gas generators, thrust chambers, turbopump assemblies, valves, propellant ducts, and auxiliary propulsion systems, as well as application of combined cycle systems to advanced propulsion techniques.

2.8.12.1.   Turbomachinery Design and Analysis   (RPTURBO) [1053]

Knowledge, capabilities and practices associated with defining, developing, integrating and verifying liquid engine turbomachinery for advanced propulsion systems. This includes the ability to derive turbomachinery design

requirements, perform design analyses necessary to size turbomachinery, define hydrodynamic and aerodynamic performance, establish geometry of flow path components, and perform trade studies required to evaluate the mechanical layout of the machine. Technical abilities include coordinating engine and turbomachinery interfaces; internal flow dynamics, heat transfer, rotordynamics, structural design, and material selection for all turbomachinery components especially high speed seals and bearings. Also includes component test planning, test integration, and data analysis.

2.8.12.2.   Combustion Devices Design and Analysis   (RPCOMBUST) [1054]

Knowledge, capabilities and practices associated with defining, developing, integrating and verifying liquid engine combustion devices for advanced propulsion systems. This includes ability to conduct preliminary design and analysis with respect to approach, dimensions, structural analysis, performance predictions and meeting engine balance requirements. Includes the ability to coordinate all activities necessary for finalization of design, fabrication, test planning, testing, and data analysis of combustion devices components which include, injectors, thrust chambers, nozzles, preburners, heat exchangers, and ignition systems.

2.8.12.3.   Valves, Lines & Ducts   (RPVALVES) [1055]

Knowledge, capabilities, and practices associated with propulsion system valves, valve actuators, lines, ducts, miscellaneous fluid components, and fluid systems, including functional design, detailed design, testing and evaluation, anomaly resolution, manufacturing techniques, assembly, inspection, insight and oversight. Knowledge pertaining to integration of valves, valve actuators, lines, ducts, and miscellaneous fluid components into flight systems, developmental systems, and ground test systems.

2.8.12.4.   Propellant Management Systems Design and Analysis   (RPPRPMMT) [1056]

Knowledge of cryogenic fluid physics and heat transfer associated with the design and development of cyrogenic tankage, insulation systems, zero boil-off, cyrocooler systems, thermodynamic vent systems, zero-G propellant management devices, zero-G liquid mass gauging, and incorporation of these into complete cryogenic propellant storage and management systems for long-duration space flight.

2.8.12.5.   Spacecraft and Auxiliary Propulsion System Design and Analysis   (RPAUXPRP) [1057]

Knowledge, capabilities and practices associated with the development of reaction control thrusters, orbital manuevering engines, pressurization systems, propellant acquisition devices and feedsystems for storable and cryogenic propellants in pressure-fed spacecraft auxiliary propulsion systems.

2.8.12.6.   Analytical and computational Fluid Mechanics (RPFLUIDMCH) [1058]

Knowledge, capabilities and practices associated with the development, validation, and application of Computational Fluid Dynamics (CFD) techniques and codes for tanks, ducts, valves, turbomachinery, and combustion components as commonly found in chemical propulsion systems (solid, liquid, and gas propellants). This involves expertise in high fidelity numerical simulation of internal flows that involve finite-rate chemistry, multiple phases, cavitation, unsteadiness, turbulence, a large range in fluid Mach number, and relative motion between elements in the simulation. Includes the pursuit of experimental research and technology projects related to obtaining data for model validation and for demonstrating advanced fluid design concepts. Requires working knowledge of thermal and structural dynamisc modeling in order to properly provide output of tasks to these other disciplines.

2.8.12.7.   Dynamic Data Analysis (RPDYNDATA) [1059]

Diagnostic evaluation of rocket engine vibration data acquired from high frequency sensors such as accelerometers, strain gauges, proximity probes, and fluctuating pressures. Data from these sensors is acquired at high speeds (10,000 to 100,000 samples/second) allowing for high frequency spectral analysis to be performed on engine/engine components. Time, frequency, and phase domain analyses results are maintained in databases that are utilized to determine engine/engine component health, statistical family comparability, and flight acceptability.

2.8.12.8.   Solid & Hybrid Motor Systems (SOLIDENG) [1108]

Knowledge, capabilities, and practices associated with the design and analysis of complex solid and hybrid rocket motor systems for rocket propulsion. Includes the ability to perform solid and hybrid motor requirements development and decomposition, trade studies and feasibility assessments, analytical modeling of solid systems, detailed and functional design and analysis of solid and hybrid motor components, subsystems, and systems, motor subsystem and system development, and validation and verification of requirements through test and analysis to ensure the motor system meets mission requirements. Includes the capability to develop and integrate motor subsystems including the propellant, liner, insulation, case, and seal and the ability to perform detailed analyses to ensure the design met its intended objectives. Includes the knowledge and skills associated with solid and hybrid motor system test formulation, analytical prediction, and data analysis and reduction including identifying appropriate test methods and techiques, test plan formulation, test article design, test matrix development, identification of special instrumentation, ballistics modelling, and test facility requirements necessary to conduct solid and hybrid motor system testing.   Ballistics modeling includes numerical simulation of the motor burn, including propellant geometry, chemistry, burn rates, gas flows, and combustion physics. Includes data analysis, reconstruction and trending to assess potential conceptual designs, to anchor mathematical models, or to ensure functional performance and identify design deficienies of as-designed propulsion systems over all flight / ground test regimes. Includes knowledge of the systems engineering tools, processes, and procedures that are required to ensure safe and reliable system development and integration.

2.8.12.9.   Liquid Engine Systems (LIQUIDENG) [1109]

Knowledge, capabilities, and practices associated with the design and analysis of complex liquid engine systems for rocket propulsion. Includes the ability to perform engine system requirements development and decomposition, trade studies and feasibility assessments, first order performance modeling, detailed and functional design, steady-state and transient performance analysis of liquid engine components, subsystems, and systems, and validation and verification of requirements through test and analysis to ensure the engine system meets mission requirements. Includes the capability to integrate engine components including turbomachinery, combustion devices, valves, and ducts and the ability to perform detailed calculations and analyses to ensure the design met its intended objectives. Includes the knowledge and skills associated with propulsion system test formulation, analytical prediction, and data analysis and reduction including identifying appropriate test methods and techiques, test plan formulation, test article design, test matrix development, identification of special instrumentation, end-to-end systems and transient modelling, and test facility requirements necessary to conduct propulsion system testing. Includes test data assessment and data evaluation to assess potential conceptual designs, to anchor mathematical models, or to ensure functional performance and identify design deficienies of as-designed propulsion systems over all flight / ground test regimes. Includes knowledge of the systems engineering tools, processes, and procedures that are required to ensure safe and reliable engine system development and integration.

2.9. Sensor Systems Competency Suite

2.9.1.   Sensors & Data Acquisition   (SENSORDATA) [20]

Knowledge, capabilities and practices associated with sensors and data acquisition systems, particularly for use in flight vehicles, payloads and/or associated ground support equipment processes, such as propulsion system sensing or vehicle health management. This includes knowledge of sensing characteristics and properties, data acquisition and data processing characteristics and properties, and system unique requirements for the safe and effective implementation of sensors and data acquisition usage in aerospace and space systems.

2.9.2. Detector Systems   (DETECTSYS) [96]

Knowledge, capabilities, and practices related to the research, design, development, characterization, and application of detectors and detector systems with an emphasis on remote sensing applications. Includes research and development of advanced detectors and detector systems covering a wide spectral range to include UV, visible, IR, and microwave. Also includes the design, development, test, characterization, and integration of detectors and detector systems into a variety of applications with an emphasis on remote sensing systems.

2.9.3. Electron Device Technology   (ELDEVTEC) [14]

Knowledge and practices associated in conducting research and development of electron device technology for communications component and systems such as microwave devices, MEMS and MMICs.

2.9.4. Laser Technology   (LASER) [92]

Knowledge of high performance, high reliability lasers and laser systems for measurement of essential planet atmospheric variables including aerosols, water vapor, ozone, wind velocity, green house gasses, ozone, and metrology applications such as ice cap thickness, as well as medicine and manufacturing technologies.   Able to apply subspecialty knowledge to research crystal materials and their frequencies, and design highly precise laser systems (such as those tunable and stable to a part per million with high spectral purity, in double pulse format with multibillion shot lifetime) that can withstand both launch and the rigors of deployment in space.

2.9.5. Microwave Systems   (MICROSYS) [94]

Applies knowledge and practices associated with the design, analysis, development and test support for devices utilizing advanced technology for instrument (including data system) and communications (including telemetry) applications. Includes knowledge and capability in one or more of the following areas; antenna systems for general electromagnetic components, communications systems for space, suborbital, aircraft, and ground applications, instrument systems (both active and passive) for space, suborbital, aircraft, and ground applications, and systems and components for instrument, communication, telemetry, and radar applications.

2.9.6. Optical Systems   (OPTSYS) [93]

Applies principles and practices related to the research, design, development, test, and evaluation and/or operation of optical components and systems, including optical sensors and optical data/image processing. Inherent within this competency is knowledge, capabilities, and practices associated with mechanically and digitally based optical instruments and associated measurement systems required to support siting, construction, assembly or operation of facilities, flight vehicles, payloads, infrastructure, and/or associated ground support equipment and processes. This includes the knowledge of light and optical theory and its application, surveying techniques; measurement equipment operation, care and calibration; measurement data acquisition and data processing techniques; and system unique requirements for the safe and effective implementation of data acquisition in a wide variety of systems.

2.9.7. Remote Sensing Technologies   (REMOTESENS) [95]

Knowledge, capabilities, and practices related to the reasearch, design, development, characterization, and application of active and passive remote sensing and detector systems. This includes advanced flight-qualified laser systems, optical components, microwave systems, radiometric sensors, and other remote sensing instruments as well as associated component subsystems, detectors, calibration systems, and data acquisition systems. Includes knowledge of, and capability to perform, research and development of advanced detectors and detector systems covering a wide spectral range to include UV, visible, IR, and microwave. May include the design, development, test, characterization, and

integration of detectors and detector systems into a variety of applications with an emphasis on remote sensing systems. Assumes a broad understanding of specialty areas such as Electro-optical, Imaging, Laser, Lidar or Optics technologies.

2.10. Structures, Materials & Mechanics Competency Suite

2.10.1. Analytical and Computational Structural Methods   (ACMSTR) [64]

Research knowledge, capability, and practices for developing computationally efficient methodologies for structural modeling, analysis, and design, for predicting response, damage tolerance, and residual strength of aerospace structures using nonlinear structural analysis methods and models, for developing validated finite element methods for special purpose computational methods including rapid optimal structural sizing, for developing analytical models for radiation protection and shielding, and for developing multi-sensory, visually immersive simulation and design methodologies for enhanced understanding and collaboration. Involves in-depth understanding of mathematics and computer science.

2.10.2. Materials Science and Engineering (MATSCIENG) [66]

Knowledge capability and practices associated with research into the characteristics and performance of materials and the design, development and testing of those materials within aerospace structures such as flight systems, ground support and facility systems. Includes the development of math models for assessment of material durability and response to environmental conditions and contaminants. Includes broad knowledge of materials disciplines, including material types such as ceramics, metallics, and polymers as well as tribology or surface science.

2.10.2.1.   Metallurgy (MSEMETAL) [1060]

Knowledge capability and practices associated with research into the production, characteristics, structure, properties, and performance of metallic materials and the design, development, processing and testing of those metals within aerospace structures such as flight systems, ground support and facility systems. Includes the development of math models and statistical methods for assessment of the durability and response of metallic materials to environmental conditions, composition, processes and applied forces. Includes broad knowledge of the metallurgical discipline, including characteristics of metallic alloy types and methods of processing metals into final products such as molding, shaping, forming, thermal treatment, joining, electrochemical processes, corrosion control, superalloys, powder metallurgy, metal matrix composites, and nanostructures. Also includes broad capabilities in metallurgical analysis, evaluation and testing , including surface, microscopic, chemical, crystallography, internal micro and macrostructural analysis, and practices in physical and mechanical testing to determine and achieve design criteria such as strength, hardness, toughness, corrosion behavior and performance in extremes of environment and temperature, with emphasis on evaluation of metals under operating environments to produce reliable and quality materials that will resist expected failue modes such as corrosion, stress concentration, metal fatigue, creep and environmental stress fracture. Includes analysis of the nature, behavior, and physical characteristics of metals and their alloys, including the mechanisms and effects by which materials react to stresses, environments, and processes in order to select, plan, design, develop processing methods and produce materials with specific and exacting properties for aerospace applications.

2.10.2.2.   Non-metallics (MSENONMET) [1061]

Knowledge capability and practices associated with research into the production, characteristics, structure, properties, and performance of non-metallic materials, including organic and inorganic polymeric materials, fiber and resin systems, as well as the design, development, processing and testing of those non-metals within aerospace structures such as flight systems, ground support and facility systems. Includes assessment of the durability and response of non-metallic materials to environmental conditions, composition, manufacturing processes and applied forces. Includes broad knowledge of the non-metallic materials engineering discipline, including characteristics of non-metal types such as ceramics, glasses, polymers, composites, thermal insulation, polymer and ceramic matrix

composites as well as methods of processing into final products. Also includes broad capabilities in analysis, evaluation and testing of non-metallics including the analysis of the nature, behavior, and physical characteristics of non-metals and their constituents, including the mechanisms and effects by which materials react to stresses, environments, and processes.

2.10.2.3.   Failure Analysis (MSEFAILURE) [1062]

Knowledge capability and practices associated with research into the characteristics and performance of materials and the design, development and testing of those materials within aerospace structures such as flight systems, ground support and facility systems, and investigation and evaluation of failed materials and surfaces to determine the root causes of failure. Includes the capability to analyze, plan, and execute failure analysis for a component fabricated of a structural material, identify failure modes and recommend improvements to resolve original problem (e.g., redesign component, which may include fabricating it from a more resistant material). Examines failures by evaluating metallurgical cross sections, plus application of the full range of etching techniques in addition to the traditional techniques based on reflected light microscopy, and also use a broad range of non-destructive testing techniques and a full range of mechanical testing equipment to quantify the failure modes and rates. Includes knowledge and practices in operation of electro-optical and diagnostic equipment (such as scanning electron microscopy, TEM, ESCA, OLM, SIMS, energy-dispersive x-ray, computerized radiography and Auger microprobe spectroscopy, etc.) to augment observations made metallographically to detect or confirm chemical contributions to failure mechanism composition, examine fractures or crack-like defects, and to analyze hardness, grain size, surface chemistry of the first few atomic layers, as well as bulk microstructural features. Includes the development of math models for assessment of material durability and response to environmental conditions and contaminants. Includes broad knowledge of materials disciplines, including material types such as ceramics, metallics, composites and polymers as well as tribology or surface science.

2.10.2.4.   Contamination Control (MSECONTAM) [1063]

Knowledge capability and practices associated with the applications in materials, processes, contamination and foreign object debris (FOD) control requirements definition and insuring proper implementation through consulting, monitoring, testing and training services. Areas of responsibility include contamination control and foreign object debris (FOD) program development addressing both ground processing and on-orbit applications as applicable. Ground processing includes all areas from design, materials procurement, manufacturing, assembly, test, transportation, storage, launch site processing and any post flight refurbishment activities. Included are laboratory analysis and testing skills useful in ground processing materials and instrumentation applications for surface cleaning and cleanliness analysis/inspection. On-orbit applications include thermal vacuum environmental or space simulation testing. Material and process evaluations related to space simulation include material and component outgas testing, sensitive hardware bake-out certification, and ultraviolet enhanced contaminant deposition characterization.

2.10.3. Mechanics and Durability   (MECHDUR) [62]

Knowledge, capability and practices associated with using and modifying advanced analytical and computational methods to assess the capability of structures to withstand applied loads and environmental conditions without failure. Includes the development of structural math models for the analysis of complex indeterminate structures, mechanical systems, and propulsion systems to determine structural response to multiple external and internal environmental conditions. Includes the performance of fatigue and fracture mechanics analyses to assess structural life. Includes broad knowledge of associated disciplines including structural dynamics, materials science, structural and mechanical design and damage tolerance. Also involves the planning and development of structural tests including measurement, instrument and test systems to assess structural characteristics and validate mathematical models.

2.10.4. Mechanical Systems   (MECHSYS) [17]

Knowledge, capability and practices involving the design, development and testing of vehicle and instrument structures, mechanisms deployment systems, associated mechanical ground support equipment and facilities structures. Includes knowledge of mechanical requirements development; mechanical system interfaces among instruments, subsystems, vehicle and ground systems; vehicle and instrument manufacturing and assembly; and vehicle and instrument alignment techniques and qualification testing. Includes knowledge of manufacturing techniques, materials, mechanical and materials standards, parametric computer aided design, mechanisms design, basic structural analysis, and knowledge of the state of best practice for complex mechanical systems.

2.10.5. Non-destructive Evaluation Sciences   (NONDESSCI) [67]

Research knowledge, capabilities, and practices for developing and applying advanced sensors, health monitoring technologies, computational techniques, and NonDestructive Evaluation (NDE) methodologies, e.g., x-ray, ultrasonic, eddy current inspection, to characterize advanced materials and structures, for developing intelligent, autonomous micro and nano-methods for characterization, health monitoring, control, and self-repair of aerospace systems, and for developing techniques and concepts for nondestructive flaw detection, manufacturing process control sensing, and instrument system miniaturization.

2.10.6. Structural Dynamics   (STRUCTDYN) [61]

Research knowledge, capabilities and practices for developing and analyzing methods to predict, verify and control structural dynamic response for aerospace structures and components including payloads, launch vehicles and propulsion systems. Involves ability to develop high fidelity integrated mechanical three-dimensional models to simulate system behavior and to provide a more thorough understanding of interactions between structures and the motion of mechanisms.

2.10.7. Thermal Structures   (THERMALSTR) [105]

Research knowledge, capabilities, and practices for designing, developing, analyzing, and validating thermal-structural concepts for aerospace systems subjected to extreme operational environments and for developing design technology for thermal-structures applications and for multiscale optimization of metallic materials, structures, and fabrication processes.

2.11.   Thermal/Fluid Competency Suite

2.11.1. Cryogenics Engineering   (CRYOENG) [26]

Knowledge, capabilities and practices associated with aerospace cryogenic systems, particularly for use in propulsion, life support, refrigeration and laboratory processes. This includes handling characteristics, material properties, system safety, and system unique requirements for the safe and effective usage of cryogenic fluids for research, development, design, analysis, test, operation and/or evaluation of cryogenic fluids storage and transfer systems for both fuels and oxidizers.

2.11.2. Fluid Systems   (FLUIDSYS) [106]

Knowledge, capabilities, and practices associated with basic fluid physics research (including microgravitational study of complex fluids, multiphase and phase change, fluid dynamics and instabilities, and interfacial phenomena), as well as

modeling and development, design, integration, analysis, test, operation and evaluation of aerospace ground and flight closed fluid systems. Knowledge of assessment of requirements, establishment of specifications and evaluation to insure proper function and compatibility of fluid systems hardware/components. Also includes integration of control logic and control systems design to ensurea a fully functional process system, and design and development of instruments for imaging fluid leaks, evaluating sensitivity, vibration susceptibility and field usability to ensure safe implementation, particularly for hydraulic and pneumatic fluid power systems. This requires the basic knowledge and skill of mechanical design, fluid physics, fluid mechanics, component design, and integrated system layouts / designs and evaluation of their capability to satisfy functional and performance requirements. Agree with recommended change, however, move under new knowledge category mechanical engineering.

2.11.3. Thermal Systems   (THERMALSYS) [104]

Knowledge, capabilities and practices associated with heat transfer, fluid flow, and thermodynamics in the design, development, testing, integration and evaluation of passive and active thermal control systems for spacecraft, propulsion systems, instruments, experiments, sensors, aircraft, ground systems, thermal protection systems and facility systems. Includes knowledge and practices in the development of advanced thermal hardware and thermal technology for future spacecraft, propulsion systems, instrument, and sensor applications including heat pipes, two-phase heat transfer systems, cryogenic systems, advanced coatings, and heat pumps. Includes knowledge of the development of math models for low and high speed convection, conduction, radiation, ablation and aeroheating.

2.12.   Multi-disciplinary R&D Competency Suite

2.12.1. Advanced Analysis and Design Method Development   (AADMD) [91]

Enable the mission and system analysis and technology trades for advanced aerospace system concepts. Knowledge of systems analysis methods for use in advanced mission analysis and aerospace systems concept development & technology assessment. Knowledge of multidisciplinary design optimization methods for use in conceptual, preliminary and detailed engineering analysis and design of aerospace vehicles and spacecraft (including design, manufacturing, and operations).

2.12.2. Advanced Measurement, Diagnostics, and Instrumentation   (ADVMDI) [111]

Knowledge, capabilities, and practices associated with research and development, assessment, implementation, and integration of advanced measurement, flow diagnostics, instrumentation to understand and discover flow physics, to develop and validate physical/chemical models, and to support aerodynamic, aerothermodynamic, acoustic, and hypersonic airbreathing propulsion design and analysis of aerospace vehicles in ground facilities and in flight. Inherent within this competency is also the ability to resolve issues arising from test articles, data systems, and integrated measurement systems and their interactions.

2.12.3. Advanced Experimentation and Testing Technologies   (AETT) [109]

Knowledge of advanced experimentation and testing philosophies and approaches that provide results to inform research activities in specialized areas such as structures, materials, airborne Systems, aerodynamics, and propulsion. Ability to develop and use specialized facilities and equipment such as wind tunnels, arc-jets, and laboratories. Includes knowledge of how to plan, conduct and interpret experimental test results to understand the interaction of test elements on the design of current and future aerospace vehicles. Also involves ability to develop, manage and enhance test processes to optimize productivity, cycle time, data quality, cost and customer satisfaction.

2.12.4. Mathematical Modeling & Analysis   (MMA) [86]

Knowledge, capabilities and practices associated with mathematical modeling, the design of algorithms and applied computational methods, simulation and analysis of physical systems to represent structural, fluid, thermal, dynamic, chemical, or other real phenomena in a quantifiable manner. This includes using manual calculations and computer simulation software. Models can refer to launch vehicle, spacecraft, ground support equipment, handling equipment, and facility/flight interface hardware related physical systems design of algorithms and applied computational methods. This includes capability in the area of quantum computing. Understanding of the physical principle represented in the model is essential to this competency.

2.12.5. Nanotechnology   (TINYTEC) [57]

Knowledge of the study of characteristics and properties of extremely small materials for development of new capabilities and applications in support of agency missions, programs and projects such as advanced structures, storage capabilities and computer systems. Includes an understanding of how to apply nanoscience findings, and a broad knowledge of other research and engineering disciplines.

2.12.6. Space Environments Science and Engineering   (SPACE_ENV) [155]

Knowledge of composition, elements, behaviors and impact of the space environments on the design, development, testing and operation of systems and components for aerospace vehicles and satellites. Involves understanding of space environments such as ionizing radiation, plasma, meteoroids, orbital debris, solar and thermal environments. Involves the ability to perform analyses to define the environments, quantify their effect on spacecraft design, development and operations and perform trade-off studies to optimize performance and assess risk.

2.12.7. Terrestrial & Planetary Environmental Science and Engineering   (PLANETENV) [23]

Knowledge of composition, elements, behaviors and impact of the terrestrial and planetary environments on the design, development, testing and operation of systems and components for aerospace vehicles and satellites. Involves understanding of atmospheric variables such as wind profiles, turbulence, cloud cover, ice/frost formation. Involves the ability to perform analyses to define the environments, quantify their effect on vehicle design, development and operations and perform trade-off studies to optimize performance and assess risk.

3. Mission Operations Knowledge Domain

3.1. Mission Operations Competency Suite

3.1.1. Advanced Technical Training Design   (ADVTEC) [3]

Knowledge of state-of-the art practices required to train technical personnel such as flight crew or ground support to accomplish objectives for near-term or futuristic missions. Identify training objectives, design training plans, tools, curricula and simulations using advanced techniques. Involves knowledge of instruction providers and tools, and how to employ and assess these resources.

3.1.2. Mission Assurance   (MA) [30]

Knowledge of methodologies and practices such as risk identification, analysis, planning, tracking and control (e.g., Certificate of Flight Readiness process, product management process) used to achieve mission, product or process

success. Activities include independent verification of product design requirements, testing validation, critical inspections, facility evaluations, flight safety analysis, development of recommendations, and tracking corrective actions.

3.1.3. Mission Execution   (MISEXC) [4]

Knowledge, capabilities and practices associated with the execution of missions, including pre-launch, launch, in-orbit and recovery operations for space flight, or conducting safe, efficient and effective operation of research or training aircraft. Manage command and control activities, payload integration and operations, robotic operations and EVA operations according to mission objectives including the technical activities and real-time decision -making and problem resolution during mission critical operations.

3.1.4. Payload Integration   (PAYLOADINT) [5]

Applies knowledge and practices of management, science and engineering to lifecycle of all payload research experiments. Ability to optimize use of existing systems for accomplishment of science objectives, and to determine engineering requirements such as payload support hardware definition, design, fabrication, integration and testing, and operating procedures. Includes ability to integrate payloads into vehicles and determine requirements and predict operating impacts between payloads and vehicles. Ability to test and process payloads, and integrate them successfully on-board the vehicle.

3.1.5. Weather Observation and Forecasting   (WOBSFR) [6]

Knowledge, capabilities and practices associated with developing or improving techniques for observing or forecasting local weather conditions in a coastal, semi-tropical environment. Specific capabilities include high resolution in-situ or remote sensing of wind, temperature and humidity; mesoscale meteorological modeling; high-resolution measurement of atmospheric electric fields and charge; radar meteorology; theoretical or numerical modeling of free electric charge generation and dissipation in clouds; and related areas. It also includes developing concepts of operation for the application of these technologies to Range operations; identifying and evaluating deficiencies in operational weather support for new or existing requirements; understanding the impact of meteorological variables on Range operations and systems; and knowledge of the application of weather data and technologies to the design of operational systems and procedures.

3.1.6. Integrated Logistics Support (INTLOGSUP) [162]

Knowledge, capabilities, concepts, and methods of strategic logistics planning, ad execution, emphasizing proactive techniques to ensure maximum logistics influence on systems acquisition as well as optimum life-cycle management of acquisition and legacy systems. Capabilities include planning, developing, implementing, and sustaining the Logistics Engineering activities necessary to satisfy support requirements while minimizing life-cycle costs; maintenance planning; manpower and support planning; supply support; support equipment to include test, measurement and diagnostic equipment (TMDE); providing technical data; training and training support; Logistics Support Analysis (LSA) for developed and modified hardware and software interfaces and components down to the piece part level on both a continual and iterative basis; generation of data inputs to the Logistics Management Information (LMI) database.

3.1.7. Program/Project Analysis   (PROJANALYS) [147]

Knowledge, capabilities and practices associated with formulating, planning, implementing, tracking and evaluating work and its associated requirements and risks, ranging from one-time projects to program-level work. Critical ability is to develop, analyze, and oversee resources, schedule, and management controls needed by the Program/Project manager to achieve the appropriate balance between resources, schedule, and technical objectives. Includes knowledge associated with finance, budgeting, schedule, configuration management, and project controls.

3.1.8. Technical Management (TECHMMT) [153]

Knowledge, capabilities, and practices of technical formulation, planning, implementing, integration and managing of complex engineering work. This includes special knowledge in field of expertise, technical resources management to meet mission specific technical milestones, and processes associated with mitigating or accepting risk.

3.2. Quality/Safety/Performance Competency Suite

3.2.1. Quality Engineering & Assurance (QEA) [29]

Knowledge, capabilities, and practices associated with the assurance of quality (aeronautic and astronautic) for all phases of the mission life-cycle including design, manufacturing, assembly, testing and operations. Capability for planning, defining, documenting, and executing quality requirements for products, processes, and systems that are suitable to the activity, proportional to the risk, and consistent with established NASA guidance, practices, and standards including NASA workmanship standards, NASA parts standards, Federal Acquisition Requirements (FAR), and NASA recommended practices for contract quality and supplier assessment. Knowledge of destructive and non-destructive material testing and inspection techniques used to validate product compliance, including related contract data deliverable requirements. Knowledge of ISO 9000 and AS 9100 series of quality standards, as well as the ability to apply these standards for complex or critical items. Ability to assess quality system compliance and effectiveness in accordance with requirements of ISO 9000 and AS 9100 quality standards. Knowledge of inspection, auditing and surveillance methods which can range from a one-time test or inspection of a product, process, or service to periodic in process monitoring of contract performance. Ability to manage, and/or evaluate the results of quality functions (audits, surveys, reports, acceptance data package/test report, etc.) performed by NASA, NASA designated/delegated representatives, and/or third party certification bodies. Ability to continually improve quality through advocacy and dissemination of advanced quality tools, techniques, technology, practices, policy, procedures, and training. Ability to perform quality data analysis and trending, to determine deficiency root cause(s), and to implement effective preventive measures.

3.2.2. Reliability & Maintainability Engineering & Assurance (RMEA) [28]

Knowledge, capabilities and practices used to design flight, ground support, and facility systems, equipment and instruments for performing their intended function for a specified interval under stated conditions (reliability) and/or have a defined capability to be restored to operational status following a failure (maintainability). Capabilities include the capacity to: define mission success criteria; define and evaluate compliance with systems/equipment reliability/maintainability requirements, including redundancy requirements; model systems/equipment from a reliability/maintainability perspective, including allocations and predictions; perform and evaluate quantitative and qualitative analyses and assessments, including failure modes and effects analyses/critical items list, probabilistic risk assessments, limited life items, quantitative computations; perform and evaluate statistical analysis, trending, and trade-offs; perform and evaluate maintenance analyses, such as reliability centered maintenance techniques; plan, perform and evaluate laboratory testing and engineering analyses; evaluate system/equipment failures to determine root cause and develop corrective actions to prevent similar failures in the future; integrate reliability/maintainability requirements, activities and results with other related disciplines (competencies) such as Safety Engineering and Assurance, Risk Management, Quality Engineering and Assurance, Human Factors, Software Assurance, Acquisition and Contract Management, and Logistics. Also includes availability which can combine the elements of reliability and maintainability in a single parameter."

3.2.3. Risk Management   (RISKMMT) [123]

Knowledge, capabilities and practices associated with the decision process associated with mitigating or accepting risks. This includes knowledge of fundamental risk management concepts, Continuous Risk Management (CRM) implementation in programs/projects, Risk-Based Acquisition Management (R-BAM) implementation for major procurements that require formal acquisition planning, and ongoing assessment of program/project risk management activities.

3.2.4. Safety Engineering and Assurance   (SAFENG) [27]

Knowledge of scientific, engineering and management principles for ensuring safety of missions and systems through controlled design, development, operation, and disposal. Includes ability to develop safety policies and to use analytical tools such as hazard analysis, failure modes and effects analysis, fault tree analysis, and probabilistic risk assessment, and develop technical reports of results, conclusions, and recommendations to support risk-informed decision-making. Develop safety performance measures and apply criteria and techniques such as safety audits, assessments, inspections, trend analysis, precursor analysis, and sampling to monitor safety performance and to identify and eliminate/mitigate hazards and achieve an acceptable level of risk, within the constraints of operational effectiveness and suitability, time, and cost throughout all phases of the system (mission) life cycle.

3.2.4.1.   System Safety   (SYSSAFETY) [1104]

Knowledge, capabilities and practices associated with the use of formal approaches to analyze hazards that impact human, environment and mission assets in order to provide decision makers with recommendations on ways to eliminate the hazards or reduce their risk to acceptable levels. Involves the ability to develop safety risk models using qualitative techniques such as System Hazard Analysis (SHA) and quantitative techniques such as Probabilistic Risk Assessment (PRA); to proactively and reactively identify the need for risk trade studies concerning resolution of hazards; to formulate risk reduction strategies; and to timely and effectively communicate safety risk insights to decision-makers.

3.2.4.2.   Probabilistic Risk Assessment   (PROBRISK) [1105]

Knowledge, capabilities and practices associated with the development and application of system risk models to support risk-informed decision making. This includes the assessment of mission success criteria, accident scenario development using logic techniques, phenomenological failure modeling, quantification of accident scenarios using probabilistic and statistical analysis techniques, consequence assessment (evaluation of the physical consequences of accident scenarios), uncertainty and risk-trade-off analysis, and risk communication.

3.2.4.3.   Trend Analysis   (TREND) [1106]

Knowledge, capabilities and practices associated with the identification of trends and patterns in data. Knowledge and demonstrated capability in statistical analysis including both classical and Bayesian statistics. Knowledge and demonstrated capability in using software packages for trend analysis, such as SPLUS, SYSTAT, or SAS. Knowledge and capabilities in data mining techniques and statistical learning approaches. Involves the ability to identify statistically significant time trends, patterns associations, outliers, and periodicities. Involves the capability to interpret the information provided by trends and patterns in terms of their program implications.

3.2.4.4.   Precursor Analysis   (PRECURSOR) [1107]

Knowledge, capabilities, and practices associated with the identification of forerunners to failure. Knowledge of risk analysis techniques and risk models to be able to infer the risk implications of conditions, events or sequences of events that are precursors to accidents. Knowledge of quantification techniques to assess the probability implications of a precursor event or a precursor sequence events. Involves the screening of data and records to identify potential candidate precursors and assessing the risk implications of the screened events to estimate the severity of the event in terms of the nearness of the event to a failure or accident. Involves the assessment of preventative or mitigative actions to determine their impact on the precursor probability or consequences.

3.2.5. Software Assurance Engineering   (SWASSURANCE) [139]

Knowledge, capabilities and practices associated with the planning, organizing, performing, monitoring and directing software assurance activities for software acquired and developed for all phases of the product lifecycle including product concept, acquisition, contractor selection and oversight, requirements, design, implementation, problem reporting, corrective action, verification and validation, testing, operations, maintenance, and retirement. SA practices include software product assurance, process assurance, quality, reliability, safety, security, risk management, verification, validation, and independent verification and validation. Additionally, demonstrate knowledge of current software and systems engineering practices, languages, management, planning, standards, procedures, and recommended processes. Assures that process and product standards are appropriate, implemented correctly, followed, and improved.

3.2.6. Configuration Management (CONFIGMMT) [154]

Knowledge of configuration management practices required to define, document, control and manage changes to the functional and physical attributes of system hardware, software, and information as applied to systems life cycle. Ability to control baselines, including identification (requirements, interfaces, and physical and functional attributes of configuration items) and control of changes to baseline. Knowledge of CM status accounting methods to record and report status of baselines. Capability to conduct audits of the overall configuration management processes performance, conduct Physical Configuration Audits, and support Functional Configuration Audits. Knowledge of NASA Program/Project management processes and the ability to plan, conduct, and evaluate the evolving baselines for NASA Programs/Projects in accordance with the NASA configuration management requirements and standards.

3.2.7. Mishap Investigation (MISHAPINV) [149]

A NASA employee who understands NASA mishap investigation policy, and requirements, and has the skills to perform all aspects of mishap investigation including preserving, collecting, and impounding evidence, interviewing, conducting analyses, drawing collusions, generating recommendations, and writing NASA mishap reports.

4. Leadership & Management Knowledge Domain

4.1. Management Competency Suite

4.1.1. Executive Management (EXECMMT) [170]

Knowledge, capabilities and practices associated with leading change, people, and work of an organization. Includes awareness and understanding of relevant strategies and techniques to effectively create a vision for change and engage others in implementing the change process. Ability to apply human capital and leadership strategies to empower teams and develop leadership capabilities in lower level managers. Ability to determine an organization's business direction and vision, and set goals that align with broader Agency objectives and related functional or program plans. Knowledge of methods for integrating work from across functional and organizational boundaries, considering complex cross-functional, cross-center, division, business and geographic implications when approaching problems or issues. Knowledge of how to apply policies and regulations that impact NASA including NASA Strategic Plan, Mission Directorate Roadmaps, President's Management Agenda, Space Act, and GPRA. Ability to assess impact of work performance on NASA's relationships with external customers and stakeholders.

4.1.2. Business Work & Team Management (BUSWORKMMT) [172]

Knowledge, capabilities and practices associated with individuals that must understand and manage both the aspects of functional business opertions, as well as management of employees and/or teams. This pseudo competency requires the supervisor or lead to have the following competencies:
- Any business management related competency
- Employee & Team Leadership
- Work Performance Leadership

4.1.3. Project Work & Team Management (PROWORKMMT) [173]

Knowledge, capabilities and practices associated with individuals that must understand and manage both the aspects of managing a project, as well as management of employees and/or teams. This pseudo competency requires the supervisor or lead to have the following competencies:
- Project Management
- Employee & Team Leadership
- Work Performance Leadership

4.1.4. Technical Work & Team Management (TECWORKMMT) [171]

Knowledge, capabilities and practices associated with individuals that must understand and manage both the aspects of technical work, as well as management of employees and/or teams. This pseudo competency requires the supervisor or lead to have the following competencies:
- Technical Management
- Employee & Team Leadership
- Work Performance Leadership

4.2. Professional Development Competency Suite

4.2.1. Program/Project Management   (PROJPROGMT) [122]

Knowledge, capabilities and practices associated with formulating, planning, implementing, managing, tracking and evaluating work and its associated requirements and risks, ranging from one-time projects to program-level work. Critical abilities are to define customer and stakeholder needs and constraints, reduce ambiguity in objectives, develop and manage an efficient project organizational structure, and apply system architecture principles to develop and manage technical requirements in order to achieve the appropriate balance between resources, schedule, and technical requirements. Includes knowledge associated with system architecture, finance, budgeting, risk assessment, schedule, configuration management, contract technical management, and project controls.

4.2.2. NASA Leadership Competency   (NASALEADER) [140]

Knowledge, capabilities and practices associated with leading and managing change, people, and work of an organization. Includes awareness and understanding of relevant strategies and techniques to effectively create a vision for change and engage others to implement the change process. Knowledge of how to apply human capital and leadership strategies to empower individuals and teams to achieve shared outcomes and develop leadership capabilities in lower level managers. Understanding of range of practices that create an environment that values diversity, promotes

inclusion of all employees, and leverages talents of all team members. Develop systems that allow effective assignment, prioritization and monitoring of work. Align work unit performance objectives with organizational objectives and removes obstacles and barriers to organizational and programmatic performance.

4.2.2.1.   Employee & Team Leadership   (LEADTEAM) [1001]

Knowledge, capabilities and practices associated with communicating business direction, goals and performance, developing and maintaining relationships and alliances, and conducting problem solving for effective decision making. Includes understanding of effective interpersonal and group communication principles and techniques to gather, comprehend and express ideas in an effective manner, and inform and influence others. Includes knowledge of techniques and approaches to resolve conflict and negotiate effective outcomes. Demonstrates ability to balance short-term needs with long-term priorities and consider complex cross-functional, cross-center, division, business and geographic implications when approaching problems or issues. Knows how to apply appropriate techniques, procedures and policies in the management of workforce to achieve work objectives and maintain effective and positive operational environments.

4.2.2.2.   Knowledge & Communication Management   (LEADCOMM) [1002]

Understands and applies knowledge management practices, theories and success factors. Possesses knowledge and capability to lead efforts to capture, organize, store and share knowledge from major team, functional community or programmatic efforts. Creates systems that facilitate communication of knowledge within NASA in order to leverage best practices, and technical know how or advancements within the Agency. Possesses knowledge of information technologies available at NASA and selects and uses those appropriately for managing work and develops strategies to integrate new technology into the workplace. Understands and applies principles of information security in relation to data publishing, technology transfer and release of information.

4.2.2.3.   Work Performance Leadership   (LEADWORK) [1003]

Knowledge, capabilities and practices associated with determining an organization's business direction and vision, and setting goals that align with broader Agency objectives and related functional or program plans. Knowledge of how to apply policies and regulations that impact NASA including NASA Strategic Plan, President's Management Agenda, Space Act, and GPRA. Ability to assess impact of work performance on NASA's relationship with external customers and stakeholders.   Ability to develop systems that facilitate the effective assignment of work and measurement of results. Knowledge of methods for integrating work from across functional and organizational boundaries.

4.2.2.4.   International Relations   (LEADGLOBAL) [1004]

Knowledge, capabilities and practices associated with forming and maintaining cross-cultural relationships and international partnerships and alliances. Understanding of the rules and policies that regulate or dictate international partnerships and how to work within those guidelines in order to accomplish objectives and sustain ongoing relationships.

5. Science Knowledge Domain

5.1. Space Sciences Competency Suite

5.1.1. Astromaterials, Collections, Curation & Analysis   (ASTROMATER) [55]

Apply knowledge of foreign materials, and planetary sciences to the collection of materials from foreign planets, and developing and using appropriate processes for handling and curating them. Includes knowledge and skill in processing the materials to protect Earth system from contamination.

5.1.2. Astrobiology   (ASTROBIO) [54]

Apply knowledge of biology, chemistry, physics, and other sciences in interdisciplinary experimental, observational, theoretical, and modeling studies of the origin, early development, and transmission of life in or on astronomical bodies and media, including the Earth and its atmosphere, and to determine how and where life arose and evolved on Earth and elsewhere, with due regard to environmental conditions and limits.

5.1.3. Astronomy & Astrophysics   (ASTRONOMY) [52]

Knowledge of the fundamental processes of radiation and dynamics for the study of the structure and composition of the Solar System, other planetary systems, stars and stellar systems, galaxies, and the structure and evolution of matter and cosmology. Use a variety of observational methods, data analysis techniques and theoretical models to characterize the physical and dynamical states of celestial objects, determine formation history and predict future evolution. Use physics and chemistry knowledge to conduct observational, experimental and theoretical studies and modeling of stars, nebulae, galaxies, and systems of stars and galaxies, and of circumstellar, interstellar and intergalactic media, particles, molecules and radiation fields, in all electromagnetic wavelength ranges. Includes study of specialty areas such as Gamma Ray & X-Ray Astronomy and Cosmic Ray Astrophysics, in which electromagnetic waves, x-ray emissions and cosmic ray particles provide data for examining the content, structure, origin and evolution of space elements.

5.1.4. Earth Atmosphere   (EARTHATM) [44]

Knowledge of the fundamental processes of radiation, chemistry and dynamics in the study of the structure and composition of the Earth's atmosphere. Conceive and implement a variety of observational methods, data analysis techniques, and theoretical models to characterize the state of the atmosphere, detect variability and explain the responsible forcing mechanisms, and predict the future state of the atmosphere. Able to develop and implement missions to conduct atmospheric research, and contribute to the development of atmospheric instrument and sensor development. Includes subspecialty knowledge in areas such as Radiation and Climate, Stratospheric & Tropospheric Chemistry.

5.1.5. Planetary Atmospheres   (PLANETATM) [163]

Knowledge of the fundamental processes of radiation, chemistry and dynamics in the study of the structure and conposition of the lower and upper atmosphiere of the panets and the origin and evolution of planetary atmospheres. Conceive and implement a variety of observational methods to characterize the state of the atmospheres of the planets-past and present, detect variability and explain the responsible forcing mechanisms, and predict the future evolution and state of planetary atmospheres instrument and tnd sensor development. Includes subspeciality knowledge in areas such as Radiation and Climate, Atmospheric Chemistry and Dynamics, Atmosphere-Surface Interactions, CelestialMechanics, Solar-Planetary Relationships, Planetary Magnetic Fields and Magnetospheres.

5.1.6. Planetary Science   (PLANETSCI) [53]

Knowledge of space science applied to conducting experimental, observational, and theoretical studies and modeling of planets, planetary satellites, asteroids, comets, meteoroids, and other objects, media, and particles in the solar system, in order to determine their composition and properties in such areas as atmospheres, magnetospheres, lithospheres, cryospheres, and interiors.

5.1.7. Space Physics   (SPACEPHY) [51]

Uses knowledge to conduct experimental, theoretical, and/or applied physics and modeling relating to matter, radiation, and their interactions, and ranging from elementary particles and fields to atomic, and nuclear physics, condensed matter physics, optical, gravitational and quantum mechanical, hydrodynamical and magnetohydrodynamical physics and General Relativity, and as applied to the nature and structure of the universe and to chemical, biological, and geophysical systems. Includes specialty areas such as solar physics, involving use of observational and experimental studies to model the Sun and its magnetic activity, characteristics, composition and influence on the Earth and other planetary bodies, as well as space plasma physics, focused on near-Earth environments such as the magnetosphere and its properties.

5.2. Earth Sciences Competency Suite

5.2.1. Biology and Biogeochemistry of Ecosystems   (BBECO) [46]

Apply knowledge of biology, biogeochemistry of ecosystems and the global carbon cycle to research, understand and predict how terrestrial and marine ecosystems change. Research ecosystems as they are affected by human activity, and as they change due to their own intrinsic biological dynamics, and as they respond to climatic variations and, in turn, affect climate. Emphasis is on an understanding of the processes of the Earth system that affect its capacity for biological productivity, explain the role of the biosphere in Earth system function, and promote proactive ecological stewardship. Ability to understand, study and properly document changes in land cover and land use.

5.2.2. Earth Science Applications Research   (EARSCIRES) [49]

Use knowledge of Earth systems and measurement technologies for designing research into Earth Science disciplines that have the objective of improving the quality of life on Earth and the longevity of the planet. Apply research to such subjects as resource and disaster management, environmental assessment, human health and safety, food and fiber, infrastructure planning, and environmental quality.

5.2.3. Earth System Modeling   (EARSYMODEL) [50]

Apply understanding of Earth systems to consolidation of scientific findings into integrated representations of atmosphere, ocean, ice land and biosphere systems, with the ability to predict future system trends and evolution of chemical and biological components.

5.2.4. Geophysical/Geologic Science   (GEOSCI) [45]

Knowledge of a wide range of disciplines related to the earth's composition, its fluid envelopes, and its position in space. Apply concepts and methods in mathematics, physics, chemistry, and biology to the problems of the atmosphere, the oceans, the solid earth, and the evolution of the planet. Involves ability to conduct far-reaching studies of the origin of the earth and solar system.

5.2.5. Geospatial Science and Technologies   (GEOSPATIAL) [88]

Applies knowledge and practices of geospatial science and has the ability to utilize and/or develop the tools for acquiring, storing, analyzing, and outputting data in multiple dimensions, as referenced to the earth by some type of real-world coordinate system (eg, a map projection). The ability to reference a geographic location as an important component in the analyses of effects or trends in biological and physical socio-economic resources. Understanding of and ability to use a variety of technology tools, such as geographic information systems (GIS), remote sensing, thematic mapping, image processing, satellite positioning systems such as the Global Positioning System (GPS), and telemetry.

5.2.6. Hydrological Science   (HYDROSCI) [47]

Knowledge of the scientific study of waters of the earth, especially with relation to the effects of precipitation and evaporation upon the occurrence and character of water in streams, lakes and on or below the land surface. Includes understanding of the hydrologic cycle from precipitation to evaporation or return of the water to the seas, and application of findings to predict rates and amounts of runoff in rivers, assess required spillway and reservoir capacities, determine soil-water-plant relationships in agriculture and manage water supplies.

5.2.7. Oceanographic Science   (OCEANSCI) [48]

Research into the composition, activities, processes and patterns in the oceans and ocean ice to increase understanding of how the marine environment interacts with the rest of the planet. Includes research on glaciers and ice sheets. Use a variety of data collection methods to collect information about the ocean and mathematically describe and predict ocean processes. Includes ability to translate data into information useful in the understanding and interpretation of the oceans themselves and their connection to other earth systems.

5.2.8. Climate Change and Variability (CLIMATE) [164]

Applies an integrated and cross discipline approach to understanding, assessing, and predicting the Earth's complex climate system. This capability draws from the other Earth Sciences related competencies to provide observations at the high accuracy required to monitor climate change, to evaluate its component processes at climate relevant time and space scales, and to enable prediction of future climate change. This research capability includes the ability to estimate the uncertainty of future climate predictions, to support impact assessments, and to develop new climate observational and modeling requirements, methods, and capabilities.

5.3. Physical Sciences Competency Suite

5.3.1. Fundamental Physics   (FUNPHYSICS) [42]

Knowledge, capabilities and practices associated with research and application of electromagnetism, continuum and classical mechanics, quantum mechanics, and thermodynamics. May also include studies in materials, cryogenics, acoustics, and electromagnetic fields ranging from DC to X-ray. It also includes the development of sensors necessary to carry out these studies. Involves ability to conduct microgravitational research designed to answer basic questions about the nature and structure of the universe and its chemical, biological and geophysical systems.

5.3.2. Icing Physics   (ICEPHYSICS) [107]

Knowledge, capabilities and practices associated with researching and understanding icing physics analysis and testing, atmospheric science, and ice sensing and protection methods.

5.3.3. Nanoscience   (TINYSCI) [56]

Knowledge, capability and practices to study and research extremely small materials is such areas as their structure, shape how they act, and how their properties change as their size changes.

5.3.4. Fluid Physics   (FLUIDPHY) [43]

Employ knowledge of the motion of fluids and the effects of such motion, to the understanding, control and improvement of industrial and natural processes. Areas of research include microgravitational study of complex fluids, multiphase and phase change, fluid dynamics and instabilities, and interfacial phenomena.

5.3.5. Advanced Materials and Processing Science   (ADVMATSCI) [65]

Research knowledge, capabilities and practices associated with the synthesis, structure, processing and properties of materials, from atomic to macroscopic, including the behavior and mechanisms by which types of materials react to stresses, processes and environments, particularly the harsh environment of space. Includes experimental research into materials such as electronic materials, glasses and ceramics, metals and alloys, lubrication materials, sealants, foams, composites and polymers for improving current and enabling future aerospace applications. Includes computational research to develop validated structure-property relationship models for all classes of materials. Includes processing, testing, and characterizing these materials to further understanding of how they can be combined or treated to improve the quality and reliability of systems, control defects and prevent contamination of operating systems or components.

5.4. Biological Sciences Competency Suite

5.4.1. Bioethics (BIOETHICS) [156]

Knowledge and experience in interpreting and implementing Federal and Agency regulations and guidelines for the protection of human and animal research subjects. Knowledge and expertise in the ethical principles that guide biomedical research. The ability to apply regulatory knowledge to implement appropriate and comprehension review mechanisms for the use of human and animal subjects in research. The ability to apply the knowledge of ethical theory and thought to guide Agency biomedical research and clinical medical policy development and decision-making.

5.4.1.1.   Biomedical and Research Clinical Ethics (BRCE) [1064]

Professional skills and knowledge of bioethics applied to a range of bioethical issues surrounding biomedical research, particularly those associated with the use of human and animal subjects in research. Broad and detailed understanding and knowledge of the evolution and development of ethical thought related to biomedical research and medical practice, to guide the development of Agency policy, and provision of expert opinion on relevant ethical issues to inform Agency decision-making.

5.4.1.2.   Research Subject Protection Regulation (RSPR) [1065]

Knowledge and a thorough understanding of the Federal and Agency regulatory framework, which governs the use of human and animal subjects in research. Knowledge of the implementation of all regulatory requirements and all applicable laws governing research subject protection. Detailed understanding of the procedural requirements for the conduct of human subjects Institutional Review Boards and Institutional Animal Care and Use Committees, and knowledge of the implementation of such Agency Boards and Committees.

5.4.2. Biomedical Research   (BIOMEDRES) [34]

Involves the capability to research, investigate and characterize the effects of space flight and exposure to microgravity, radiation, and other stresses on physiological functions (e.g., musculoskeletal, cardiovascular, etc.). In-depth understanding of the human body, its physical and chemical make-up and the associated technology and methods to examine the effects of various environments and stresses.   Ability to understand the underlying physiological, behavioral and psychological mechanisms and performance aspects responsible for biomedical and behavioral changes in humans and animals during spaceflight and apply this information to conduct operational and clinical research to develop, and validate countermeasures that will ensure the health, safety and performance of flight crews involved during launches, landings, and while in space.

5.4.3. Cell & Molecular Biology   (CELLBIO) [31]

Knowledge of and ability to conduct research on basic cellular function and properties such as gene regulation and expression or mechanoreception, that may be directly or indirectly impacted by altered gravitational force and other space-related effects. Includes biotechnology, tissue engineering, study of the dynamics of cell behavior and interactions and differentiation in cellular systems within and across organisms under a variety of environmental conditions, such as the physiological changes seen in whole animals in response to the space environment, and development of biosentinels.

5.4.4. Developmental Biology   (DEVELOPBIO) [32]

Knowledge of and ability to conduct research on the processes of development, differentiation, and growth in animals and plants at the molecular, cellular, and genetic levels.

Appendix A: Competency ID Number Cross-Reference Table

X	Comp ID	Designator	Title	Page	Comp Stakeholder
	1	MAP	Mission Analysis and Planning	32	Engineering Community
	2	FLTDSG	Mission Flight Design	32	Engineering Community
	3	ADVTEC	Advanced Technical Training Design	53	Center Operations Community
	4	MISEXC	Mission Execution	54	Center Operations Community
	5	PAYLOADINT	Payload Integration	54	Center Operations Community
	6	WOBSFR	Weather Observation and Forecasting	54	Center Operations Community
	7	SYSTEMSENG	Systems Engineering	30	Engineering Community
	8	DESDEVENG	Design and Development Engineering	27	Engineering Community
	9	INTEGENG	Integration Engineering	28	Engineering Community
	10	TESTENG	Test Engineering	30	Engineering Community
	11	ENGSCISUP	Engineering and Science Support	28	Engineering Community
	12	ELMAG	Electromagnetics	43	Engineering Community
	13	ELSYS	Electrical and Electronic Systems	40	Engineering Community
	14	ELDEVTEC	Electron Device Technology	48	Engineering Community
	15	ELMECHSY	Electro-Mechanical Systems	40	Engineering Community
	16	MICROELMEC	Micro-Electromechanical Systems	43	Engineering Community
	17	MECHSYS	Mechanical Systems	51	Engineering Community
	18	PYROTECH	Pyrotechnics	38	Engineering Community
	19	FLTGNDSYS	Flight and Ground Data Systems	41	Engineering Community
	20	AEROSEN	Sensors & Data Acquisition	47	Engineering Community
	21	AVIONICS	Avionics	40	Engineering Community
	22	GNC	Control Systems, Guidance & Navigation	41	Engineering Community
	23	PLANETENV	Terrestrial & Planetary Environments Science & Engineer…	53	Engineering Community
	24	MANUFACT	Manufacturing Engineering	29	Engineering Community
	25	CHEMENG	Chemistry/ Chemical Engineering	37	Engineering Community
	26	CRYOENG	Cryogenics Engineering	51	Engineering Community
	27	SAFENG	Safety Engineering and Assurance	56	Safety & Mission Assurance
	28	RMEA	Reliability & Maintainability Engineering & Assurance	55	Safety & Mission Assurance
	29	QEA	Quality Engineering & Assurance	55	Safety & Mission Assurance
	30	MA	Mission Assurance	53	Safety & Mission Assurance
	31	CELLBIO	Cell & Molecular Biology	64	Science Community
	32	DEVELOPBIO	Developmental Biology	64	Science Community
X	33	NEUROBIO	*Neurobiology (use 34)* **INACTIVE**	-	Science Community
	34	BIOMEDRES	Biomedical Research	64	Science Community
	35	BIOMEDENG	Biomedical Engineering	34	Engineering Community
	36	AEROMED	Aerospace Medicine	34	Health & Medical Systems
	37	ECLSS	Environmental Control and Life Support Systems	35	Engineering Community
	38	EAS	Extravehicular Activity Systems	35	Engineering Community
	39	ENVFACT	Environmental Factors	35	Engineering Community

X	Comp ID	Designator	Title	Page	Comp Stakeholder
	40	HUMFACTRES	Fundamental Human Factors Research	35	Safety & Mission Assurance
	41	HUMFACTENG	Human Factors Engineering	37	Safety & Mission Assurance
	42	FUNPHYSICS	Fundamental Physics	62	Science Community
	43	FLUIDPHY	Fluid Physics	63	Engineering Community
	44	EARTHATM	Earth Atmosphere	60	Science Community
	45	GEOSCI	Geophysical/Geologic Science	61	Science Community
	46	BBECO	Biology and Biogeochemistry of Ecosystems	61	Science Community
	47	HYDROSCI	Hydrological Science	62	Science Community
	48	OCEANSCI	Oceanographic Science	62	Science Community
	49	EARSCIRES	Earth Science Applications Research	61	Science Community
	50	EARSYSMODEL	Earth System Modeling	61	Science Community
	51	SPACEPHY	Space Physics	61	Science Community
	52	ASTRONOMY	Astronomy and Astrophysics	60	Science Community
	53	PLANETSCI	Planetary Science	61	Science Community
	54	ASTROBIO	Astrobiology	60	Science Community
	55	ASTROMATER	Astromaterials, Collections, Curation & Analysis	60	Science Community
	56	TINYSCI	Nanoscience	63	Science Community
	57	TINYTEC	Nanotechnology	53	Engineering Community
	58	BIOENG	Bioengineering	34	Engineering Community
	59	BIOMIMETIC	Biomimetics	34	Engineering Community
	60	COMNETENG	Communication Networks & Engineering	40	Engineering Community
	61	STRUCTDYN	Structural Dynamics	51	Engineering Community
	62	MECHDUR	Mechanics and Durability	50	Engineering Community
X	63	STRUCTSYS	*Structural Systems (use 1028)* **INACTIVE**	-	Engineering Community
	64	ACMSTR	Analytical and Computational Structural Methods	49	Engineering Community
	65	ADVMATSCI	Advanced Materials and Processing Science	63	Engineering Community
	66	MATSCIENG	Materials Science and Engineering	49	Engineering Community
	67	NONDESSCI	Non-destructive Evaluation Sciences	51	Engineering Community
	68	PROSYS	Propulsion Systems & Testing	45	Engineering Community
	69	AIRPRO	Airbreathing Propulsion	44	Engineering Community
	70	HAIRPRO	Hypersonic Airbreathing Propulsion	44	Engineering Community
	71	HYPERSYS	Hypergolic Systems	44	Engineering Community
	72	ADVPRO	Advanced In-Space Propulsion	43	Engineering Community
	73	ROCKETPRO	Rocket Propulsion	45	Engineering Community
	74	BOOMSCI	Combustion Science	44	Science Community
	75	PWRSYS	Power Systems	45	Engineering Community
	76	PWRENG	Power - Energy Storage	45	Engineering Community
	77	PWRPHO	Power Generation - Photovoltaics	45	Engineering Community
	78	PWRTHM	Power Generation - Thermal Systems	45	Engineering Community
	79	ROBOTICS	Robotics	39	Engineering Community
	80	COMPSYSENG	Computer Systems and Engineering	38	Engineering Community
	81	NETSYS	Network Systems and Technology	39	Engineering Community
	82	SWENG	Software Engineering	39	Engineering Community

X	Comp ID	Designator	Title	Page	Comp Stakeholder
X	83	DAMSSYS	*Data Acquisition, Management and Storage Systems (use 1099)* **INACTIVE**	-	Engineering Community
	84	NEUNETSYS	Neural Networks & Systems	39	Engineering Community
	85	IASYS	Intelligent/Adaptive Systems	39	Engineering Community
	86	MMA	Mathematical Modeling & Analysis	53	Engineering Community
X	87	DATAVIS	*Data Visualization (use 1100)* **INACTIVE**	-	Engineering Community
	88	GEOSPATIAL	Geospatial Science and Technologies	62	Science Community
	89	ADVMIS	Advanced Mission Analysis	31	Engineering Community
	90	ASCDTA	Aerospace Systems Concept Development & Technology …	31	Engineering Community
	91	AADMD	Advanced Analysis and Design Method Development	52	Engineering Community
	92	LASER	Laser Technology	48	Engineering Community
	93	OPTSYS	Optical Systems	48	Engineering Community
	94	MICROSYS	Microwave Systems	48	Engineering Community
	95	REMOTESENS	Remote Sensing Technologies	48	Engineering Community
	96	DETECTSYS	Detector Systems	48	Engineering Community
	97	CSAOPS	Crew Systems and Aviation Operations	35	Engineering Community
	98	FLTDYN	Flight Dynamics	33	Engineering Community
X	99	APPLAERO	*Applied Aerodynamics (inactive)* **INACTIVE**	-	Engineering Community
	100	AEROELA	Aeroelasticity	33	Engineering Community
	101	AERODYN	Aerodynamics	33	Engineering Community
	102	AEROTHM	Aerothermodynamics	33	Engineering Community
	103	ACOUSTICS	Acoustics	32	Engineering Community
	104	THERMALSYS	Thermal Systems	52	Engineering Community
	105	THERMALSTR	Thermal Structures	51	Engineering Community
	106	FLUIDSYS	Fluid Systems	51	Engineering Community
	107	ICEPHYSICS	Icing Physics	63	Science Community
	108	AIRTRAFFIC	Air Traffic Systems	33	Engineering Community
	109	AETT	Advanced Experimentation and Testing Technologies	52	Engineering Community
	110	SIMFLTSYS	Simulation/Flight Research Systems	34	Engineering Community
	111	ADVMDI	Advanced Measurement, Diagnostics, and Instrumentation	52	Engineering Community
	112	FACENG	Facilities Engineering and Management	23	Institutions Community
	113	BUSMMT	Business Management	15	Center Operations Community
	114	PROCESSENG	Process Engineering	29	Engineering Community
	115	PROFADMOPS	Professional Administrative Operations	26	Center Operations Community
	116	BUSDEV	Partnership & Business Development	14	External Relations Community
	117	COMTEC	Commercial Technology	15	External Relations Community
	118	FINMMT	Financial Management	19	Financial Community
	119	BUDGETMMT	Budgeting Management	18	Financial Community
	120	INTAUD	Internal Control / Audit	19	Financial Community
	121	COSTEST	Cost Estimation and Analysis	19	Financial Community
	122	PROJPROGMT	Program/Project Management	58	Agency / CM Program
	123	RISKMMT	Risk Management	56	Safety & Mission Assurance
	124	CONMMT	Acquistion and Contract Management	18	Procurement Community

X	Comp ID	Designator	Title	Page	Comp Stakeholder
	125	LEGALAPP	Legal Application Practice	16	General Counsel Community
	126	SECURITY	Security & Program Protection	20	Security Mgmt Community
	127	INSCOMP	Inspection, Investigation and Compliance	15	Security Mgmt Community
	128	HUMCAPMMT	Human Capital Management	25	Human Resources Community
	129	EEOMMT	Equal Opportunity Management	26	EEO Community
	130	OCCHEALTH	Occupational and Environmental Health	22	Health & Medical Systems
	131	BITSYS	Business IT Systems	14	Information Technology
X	132	RESFACPLAN	*Research Facilities Planning* **INACTIVE**	-	Institutions Community
	133	ENVENGMMT	Institutional Environmental Engineering & Management	19	Institutions Community
	134	LOGSUPTRAN	Institutional Logistics, Supply and Transportation	20	Institutions Community
	135	PUBLICOMM	Public Communications & Outreach	17	Public Affairs Community
	136	GOVAF	Governmental Affairs	15	Legislative Affairs Community
	137	EDTECH	Education Programs and Technologies	15	Education Community
	138	NUCLEARENG	Nuclear Engineering/Propulsion	44	Engineering Community
	139	SWASSURANCE	Software Assurance Engineering	57	Safety & Mission Assurance
	140	NASALEADER	NASA Leadership Competency	58	Agency / CM Program
X	141	PERSCOMM	*Personal Communication* **INACTIVE**	-	Human Resources Community
X	142	RELATIONSHIP	*Relationship Management* **INACTIVE**	-	Human Resources Community
	143	FIREPROT	Fire Protection Engineering	20	Safety & Mission Assurance
	144	EXPORT	Export Control	15	External Relations Community
X	145	INSFACPLAN	*Institutional Facilities Planning* **INACTIVE**	-	Institutions Community
X	146	INSFACOPS	*Institutional Facilities Operations* **INACTIVE**	-	Institutions Community
	147	PROJANALYSIS	Program/Project Analysis	54	Agency / CM Program
X	148	RESFACOPS	*Research Facilities Operations* **INACTIVE**	-	Institutions Community
	149	MISHAPINV	Mishap Investigation	57	Safety & Mission Assurance
	150	WORKSAFETY	Workplace Safety	24	Safety & Mission Assurance
	151	EMERGMMT	Emergency Management	21	Safety & Mission Assurance
	152	AIROPS	Institutional Aircraft Operations	24	Center Operations Community
	153	TECHMMT	Technical Management	55	Agency / CM Program
	154	CONFIGMMT	Configuration Management	57	Agency / CM Program
	155	SPACE_ENV	Space Environments Science and Engineering	53	Engineering Community
	156	BIOETHICS	Bioethics	63	Health & Medical Systems
	157	INTLPGMDEV	International Program Development	17	External Relations Community
	158	DIVERSEMMT	Diversity Management	25	EEO Community
	159	WIRELESS	Wireless Communications and Telemetry	43	Engineering Community
	160	METROLOGY	Metrology and Calibration Competency	43	Engineering Community
	161	DATSYS	Data Systems and Technology	38	Engineering Community
	162	INTLOGSUP	Integrated Logistics Support	54	Center Operations Community
	163	PLANETATM	Planetary Atmospheres	60	Science Community
	164	CLIMATE	Climate Change and Variability	62	Science Community
	165	PARABUSOPS	Para-Professional Business Operations	26	Agency / CM Program
	166	IMAGING	Imaging Analysis	40	Engineering Community
	167	MASTERPLAN	Master Planning	20	Institutions Community

X	Comp ID	Designator	Title	Page	Comp Stakeholder
	168	FACLTYPLAN	Research, Development or Flight Facility Planning	24	Institutions Community
	169	POLICYMMT	Policy Management	17	Institutions Community
	170	EXECMMT	Executive Management	57	Agency / CM Program
	171	TECWORKMMT	Technical Work & Team Management	58	Agency / CM Program
	172	BUSWORKMMT	Business Work & Team Management	58	Agency / CM Program
	173	PROWORKMMT	Project Work & Team Management	58	Agency / CM Program
	174	STUDENT	Student Trainee	26	Human Resources Community
	175	SIMULATE	Simulation Systems	32	Engineering Community
	176	LEGALSUP	Legal Assistance	16	General Counsel Community
			LEVEL 2 COMPETENCIES		
	1001	LEADTEAM	Employee & Team Leadership	59	Agency / CM Program
	1002	LEADCOMM	Knowledge & Communication Management	59	Agency / CM Program
	1003	LEADWORK	Work Performance Leadership	59	Agency / CM Program
	1004	LEADGLOBAL	International Relations	59	Agency / CM Program
	1005	HFRBIOMECH	Biomechanics and Ergonomics Fundamental Research	35	Safety & Mission Assurance
	1006	HFRHABIT	Habitability and Environmental Psychology Fundamental …	36	Safety & Mission Assurance
	1007	HFRPERCEPT	Perception and Psychophysics Fundamental Research	36	Safety & Mission Assurance
	1008	HFRPSYPHY	Psychophysiology Fundamental Research	36	Safety & Mission Assurance
	1009	HFRFATIGUE	Fatigue, Alertness, Circadian Rhythms Fundamental …	36	Safety & Mission Assurance
	1010	HFRCOG	Cognitive Science Fundamental Research	36	Safety & Mission Assurance
	1011	HFRCOMM	Communication and Knowledge Management Fundamen…	36	Safety & Mission Assurance
	1012	HFRDECISMK	Decision Making and Risk Management Fundamental …	36	Safety & Mission Assurance
	1013	HFRORG	Organizational Science Fundamental Research	36	Safety & Mission Assurance
	1014	HFRHUMMACH	Human-Machine Interaction Fundamental Research	36	Safety & Mission Assurance
	1015	HFRMANCNTL	Manual Control Fundamental Research	36	Safety & Mission Assurance
	1016	HFRSUPCNTL	Supervisory Control Fundamental Research	36	Safety & Mission Assurance
	1017	HFRTRNG	Training and Adaptation Fundamental Research	36	Safety & Mission Assurance
	1018	HFRHUMPERF	Human Performance Fundamental Research	36	Safety & Mission Assurance
	1019	HFEBIOMECH	Biomechanical Engineering, Technology, Standards	37	Safety & Mission Assurance
	1020	HFEERGO	Ergonomics Engineering, Technology, and Standards	37	Safety & Mission Assurance
	1021	HFESPACE	Space Human Factors Engineering, Technology, …	37	Safety & Mission Assurance
	1022	HFEHABIT	Habitability Engineering, Technology, and Standards	37	Safety & Mission Assurance
	1023	HFEPERCEPT	Perceptual Technologies and Standards	37	Safety & Mission Assurance
	1024	HFECOG	Cognitive Technologies	37	Safety & Mission Assurance
	1025	HFEHUMAUTO	Human-Automation System Design	37	Safety & Mission Assurance
	1026	HFETRNG	Training Technologies	37	Safety & Mission Assurance
	1027	HFEHUMERR	Human Reliability and Human Error Analysis	37	Safety & Mission Assurance
	1028	DDESTRUCT	Structural Design and Development Engineering	27	Engineering Community
	1029	DDEELECT	Electrical Design and Development Engineering	27	Engineering Community
	1030	DDEPROP	Propulsion Design and Development Engineering	27	Engineering Community
	1031	DDETEST	Test Fixtures and GSE Design and Development Eng…	28	Engineering Community
	1032	INTSTRUCT	Structural Integration Engineering	28	Engineering Community

X	Comp ID	Designator	Title	Page	Comp Stakeholder
	1033	INTMATER	Materials Integration Engineering	28	Engineering Community
	1034	INTSYSTEMS	Systems Integration Engineering	29	Engineering Community
	1035	INTELECT	Electrical Integration Engineering	29	Engineering Community
	1036	INTPROPEL	Propulsion Integration Engineering	29	Engineering Community
	1037	TSTSTRUCT	Structural Test Engineering	30	Engineering Community
	1038	TSTMATER	Materials Test Engineering	30	Engineering Community
	1039	TSTTHERMO	Thermal Test Engineering	31	Engineering Community
	1040	TSTELECT	Electrical Test Engineering	31	Engineering Community
	1041	TSTPROP	Propulsion Test Engineering	31	Engineering Community
	1042	ELINSTR	Instrumentation Systems	40	Engineering Community
	1043	ELEEPART	EEE Parts	41	Engineering Community
	1044	ELPARTSPKG	Parts & Packaging	41	Engineering Community
	1045	ELCIRCUITS	Electrical Circuits Engineering	41	Engineering Community
	1046	GNCSPACE	Spacecraft & Stabilization Control Design and Analysis	41	Engineering Community
	1047	GNCVEHCNTL	Vehicle Control Design and Analysis	42	Engineering Community
	1048	GNCGUIDE	Guidance Design and Analysis	42	Engineering Community
	1049	GNCNAVSYS	Navigation System Design and Analysis	42	Engineering Community
	1050	APELEC	Electric Propulsion	44	Engineering Community
	1051	APNOPROP	Propellantless Prop	44	Engineering Community
	1052	APCHEM	Advanced Chemical & Thermal Prop	44	Engineering Community
	1053	RPTURBO	Turbomachinery Design and Analysis	45	Engineering Community
	1054	RPCOMBUST	Combustion Devices Design and Analysis	46	Engineering Community
	1055	RPVALVES	Valves, Lines & Ducts	46	Engineering Community
	1056	RPPRPMMT	Propellant Management Systems Design and Analysis	46	Engineering Community
	1057	RPAUXPRP	Spacecraft and Auxiliary Propulsion System Design …	46	Engineering Community
	1058	RPFLUIDMCH	Analytical and computational Fluid Mechanics	46	Engineering Community
	1059	RPDYNDATA	Dynamic Data Analysis	46	Engineering Community
	1060	MSEMETAL	Metallurgy	49	Engineering Community
	1061	MSENONMET	Non-metallics	49	Engineering Community
	1062	MSEFAILURE	Failure Analysis	50	Engineering Community
	1063	MSECONTAM	Contamination Control	50	Engineering Community
	1064	BRCE	Biomedical and Research Clinical Ethics (BRCE)	63	Health & Medical Systems
	1065	RSPR	Research Subject Protection Regulation (RSPR)	63	Health & Medical Systems
	1066	OCCMED	Occupational Medicine	22	Health & Medical Systems
	1067	OCCHYGIENE	Industrial Hygiene	22	Health & Medical Systems
	1068	OCCPHYSICS	Health Physics	22	Health & Medical Systems
	1069	OCCASSIST	Employee Assistance	23	Health & Medical Systems
	1070	MDPRACTICE	Medical Practice	34	Engineering Community
	1071	MDBEHAVIOR	Behavioral Health	34	Engineering Community
	1072	SECPHYSCL	Physical Security	21	Security Mgmt Community
	1073	SECOUNTER	Counterintelligence/Counterterrorism Analysis, Investigat…	21	Security Mgmt Community
	1074	SECINFO	Information Security	21	Security Mgmt Community
	1075	SECNATION	National Security Systems	21	Security Mgmt Community

X	Comp ID	Designator	Title	Page	Comp Stakeholder
	1076	SECPERSON	Personnel Security	21	Security Mgmt Community
	1077	SECINDUST	Industrial Security	21	Security Mgmt Community
	1078	BITPLAN	Information Resources Planning and Evaluation	14	Information Technology
	1079	BITARCH	IT Architecture	14	Information Technology
	1080	DATDBMMT	Database Management Systems	38	Engineering Community
	1081	BITSECURE	Information Systems Security	14	Information Technology
	1082	PARALEGAL	Paralegal	16	General Counsel Community
	1083	INTLPROPLAW	Intellectual Property Law	16	General Counsel Community
	1084	GENERALLAW	General Law	16	General Counsel Community
	1085	CONTRACTLAW	Contracts Law	16	General Counsel Community
	1086	PERSONLAW	Personnel/EEO Law	16	General Counsel Community
	1087	ENVLAW	Environmental/Real Property Law	17	General Counsel Community
	1088	ENVPLAN	Institutional Environmental Planning/NEPA	19	Institutions Community
	1089	ENVREMED	Institutional Environmental Remediation	20	Institutions Community
	1090	FACIVENG	Facility Civil Engineering	23	Institutions Community
	1091	FACMECHENG	Facility Mechanical Engineering	23	Institutions Community
	1092	FACELECENG	Facility Electrical Engineering	23	Institutions Community
	1093	ACQPLAN	Acquisition Planning	18	Procurement Community
	1094	CONFORMAT	Contract Formation	18	Procurement Community
	1095	CONPERFORM	Contract Management and Performance Assessment	18	Procurement Community
	1096	FACCONSTMMT	Construction Management	23	Institutions Community
	1097	FACPROPERTY	Real Property Management	23	Institutions Community
	1098	FACOPSMAIN	Facilities Operations and Maintenance	24	Institutions Community
	1099	DATLARGE	Large Scale Data Systems	38	Engineering Community
	1100	DATVISUAL	Data Visualization	38	Engineering Community
	1101	STUTECH	Technical Student Trainee	27	Human Resources Community
	1102	STUCLERICAL	Clerical Student Trainee	27	Human Resources Community
	1103	STUPROFADM	Professional Administrative Student Trainee	27	Human Resources Community
	1104	SYSSAFETY	System Safety	56	Safety & Mission Assurance
	1105	PROBRISK	Probabilistic Risk Assessment	56	Safety & Mission Assurance
	1106	TREND	Trend Analysis	56	Safety & Mission Assurance
	1107	PRECURSOR	Precursor Analysis	56	Safety & Mission Assurance
	1108	SOLIDENG	Solid & Hybrid Motor Systems	47	Engineering Community
	1109	LIQUIDENG	Liquid Engine Systems	47	Engineering Community
	1110	GNCCTLCOM	Control Components	42	Engineering Community
	1111	GNCCTLELE	Control Electronics	42	Engineering Community
	1112	INTLLAW	International Law	17	General Counsel Community
	1113	COMMLAW	Commercial Law	17	General Counsel Community
	1114	PATENTAGT	Patent Agent	16	General Counsel Community
	1115	HCMCLASS	Classification	25	Human Resources Community
	1116	HCMCOMP	Compensation	25	Human Resources Community
	1117	HCMEMPBENF	Employee Benefits	25	Human Resources Community
	1118	HCMEMPDEV	Employee Development	25	Human Resources Community

X	Comp ID	Designator	Title	Page	Comp Stakeholder
	1119	HCMEMPREL	Employee Relations	25	Human Resources Community
	1120	HCMLABOR	Labor Relations	25	Human Resources Community
	1121	HCMPERFMGT	Performance Management	26	Human Resources Community
	1122	HCMRECRUIT	Recruitment/Placement	26	Human Resources Community
	1123	HCMWORKPLN	Workforce Planning	26	Human Resources Community

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Workforce Competency Dictionary

Appendix B: Guidelines for evaluating levels of proficiency

In the NASA Competency Model, levels of proficiency are intended to reflect an individual's depth of expertise in a competency. This section provides guidelines and criteria for assessing an individual's expertise level.

How will Tier Levels be used?

❑ Tier levels will be used by professional communities and agency functional offices to understand the capabilities of the workforce and better align that workforce with the agency's mission , current needs, and future demands.

❑ The tier levels will be used by employees, managers, professional communities, functional offices, and leadership to help locate expertise in the agency in a reliable and systematic way.

❑ Tier levels will be used in the employee development process to help employees, managers, and the human resource development community identify gaps and proficiency targets and provide opportunities to refine or enhance the individual's level of expertise in a selected competency.

What are the Tier Levels?

❑ **Tier level 1** *"Basic Knowledge"* : An individual has a basic knowledge of the subject matter and shows an awareness of how this competency relates to their job.

❑ **Tier level 2** *"Working Knowledge"* : An individual has a working knowledge of the subject matter such that they are able to effectively apply that in their job.

❑ **Tier level 3** *"Proficient"* : Through the experience of applying their knowledge on the job, or other related activities, an individual has developed a thorough understanding of the subject matter AND is highly proficient in being able to apply that knowledge in their work environment.

❑ **Tier level 4** *"Subject Matter Expert"* : Through years of experience, or advanced study, an individual has developed a comprehensive understanding of the subject matter and its interactions with other disciplines/competencies. The individual has advanced their set of skills to be able to apply their expertise to a multitude of projects and situations. The individual utilizes their in-depth knowledge to communicate and collaborate with peers within their normal work environment and outside to other professional business or technical communities.

How do you evaluate the Tier Levels?

❑ Compare an individual's expertise in each competency with the "Tier Indicators Table" to determine their proficiency level.

❑ The tier definition will in most cases provide an adequate benchmark on which to base your assessment.

❑ For a more refined analysis, use the general indicators in the knowledge measurement section of the table. You should be able to meet the intent for all of the items listed under a single tier column.

> NOTE: If you fail to meet one or two of the items, you may still select this tier rating providing that you meet the overall intent of the tier definition. However, this may show some areas where additional development or experience is needed.

If you would like more information, or detailed instructions, read the sections below.

Employee Competency Identification & Self Assessment

❑ Using the competency dictionary, identify the competencies that best describe your areas of expertise or knowledge.
❑ Log into the CMS tool and select or add the competencies you have identified as part of your personal portfolio.
❑ For each competency, identify your level of proficiency and submit your self-assessed tier rating. In making these assessments you will need to:
  ‣ Review the "tier level assessment example" and "important things to keep in mind" in the sections below.
  ‣ Review Appendix D of the CMS Dictionary to determine if there are any specific tier indicators established by the functional/professional community
  ‣ Review the tier definitions and general indicators in the "Tier Indicators Table" below.

❑ OPTIONAL: For each competency, you can submit rationale for how you determined your rating, or you can provide supporting information that relates your experience in applying your competency. This information can help your supervisor with their assessment, as well as, help peers and other employees locate someone with your particular expertise.

Manager Competency Assessment and Validation

❑ Identify the competencies for the employees that are to be assessed. At a minimum, you should be reviewing competencies where the employee has identified themselves at Tier level 3 or 4, or where they have elected not to perform a self-assessment. (Note: *The system allows you to validate any and all levels at anytime*)
❑ Evaluate the employee's level of expertise for each competency being reviewed. In making your assessments you will need to:
  ‣ Review & discuss with the employee their past jobs, projects, and activities in relation to their competencies. (Note: *Some of this information may have been submitted by the employee in the CMS Tool when they updated their portfolio.*)
  ‣ Review the "tier level assessment example" and "important things to keep in mind" in the sections below.
  ‣ Review Appendix D of the CMS Dictionary to determine if there are any specific tier indicators established by the functional/professional community
  ‣ Review the tier definitions and general indicators in the "Tier Indicators Table" below.

❑ Log into the CMS tool and submit your assessed tier rating for each competency and employee being reviewed.

NOTE: *There is an optional comment block in which you may choose to provide as part of your assessment:*
  • *an explanation for your tier rating, or,*
  • *supporting information that was used to help make your assessment, or,*
  • *notes about areas needing additional employee development or experience.*

❑ Discuss with the employee the results of your assessment and any opportunities for further competency development.

Questions/Feedback/Suggestions

For suggestions on improvements to the tier level general criteria, the tier evaluation process, or any competency specific criteria, you can submit your comments online in the CMS Tool or please contact the CMS Operation Manager at your Center.

IMPORTANT Things to keep in mind

- <u>The tier levels are intended to reflect an individual's level of expertise for specific competencies.</u>
  Tier level assessments do not represent an employee's   overall capability or their performance level for his/her current position. Be careful not to misconstrue the knowledge measurement areas as performance standards.
  - ▸ *As an example: The CMS Tier validation process identifies an individual's level of proficiency by looking at how the employee uses his/her knowledge/expertise to identify and resolve specific competency related problems. It is not to evaluate the employee's overall skill in solving problems.*
  - ▸ Where does this become a factor or issue? You may consider that an individual exhibits tier level 3 expertise in solving problems relating to his/her knowledge of robotics. That does not mean, that the employee can solve problems of a similar nature at this same level in other competency areas, such as budget management.
  - ▸ **Rule of Thumb: Consider the individual's expertise for each competency to be unique. Therefore, each competency for every person should be evaluated based on it's own merits.**

- <u>In some cases, grade levels can help with your assessment, but is not a true measure of expertise.</u>
  Example: A person typically advances in responsibility and grade level as a result of their experience and performance. You can show that in most cases, this is an indirect measurement of their level of expertise. As a person becomes more knowledgeable in their discipline and in their skill to apply that knowledge, they can improve their performance and increase their scope of responsibility. However, not all positions/promotions work this way. Sometimes employees are promoted due to other qualifications or skills, not because they are the subject matter expert. As an example, for most management positions, individuals are selected for their leadership and management skills as much as, or more than, their technical expertise.

- <u>Tier level evaluations reflect the employee's expertise, not the level of expertise required by the position the employee encumbers.</u>
  There will be cases where the tier proficiency required by position may be higher or lower than the employee's current capability. The evaluation should be for the employee at his/her current level of expertise, not the level the position requires..

- <u>Time alone is not a measure of a person's level of proficiency</u>.
  With time and experience, most individuals will become very good at what they do. So in this validation process, the expectation is that most people with sufficient experience will be assessed at Tier level 3 "Proficient in their competency". However, to become a subject matter expert the expectation is that an individual had done something extra to develop their expertise, beyond the experienced gained over time from performing well in the same or similar type of job.

- <u>The tier indicators are simple guidelines</u>.
  It is not an exhaustive list, nor are the criteria perfect. It is intended to be used as a common frame of reference, so no matter the professional discipline, the organization, or the individual, everyone understands the scope and context around the information being collected and presented in reports.

Tier Level Assessment Example

The following example shows how tier levels might be applied in a typical career development scenario. For this example, a person graduates from college, is hired by NASA, and works in a specific field for over 20 years. It illustrates the expectations of this process and provides a frame of reference to help relate other career development scenarios.

- An individual graduates with an electrical engineering degree and is hired in a GS-854-7 AST, computer engineering position to work test and checkout on the Space Shuttle Main Engines avionics system.

- After several months to a year , the employee begins to relate her education to the principles of the avionics competency and how it is applied in the shuttle test and checkout process. The employee would select "Avionics" as one of her competencies at Tier Level 1 "Basic Knowledge". (For reference, the employee is at the GS-7/9 level.)

- After 1 to 3 years in this position, the employee would take training classes, learn on the job, and gain experience from applying her knowledge on the various checkout tasks. This would advance her expertise to a Tier Level 2 "Working Knowledge". (The employee is at the GS-11 level.)

- After 3 to 7 years, the employee would continue to learn more about avionics systems, how to test, how to troubleshoot, how to analyze data, how to develop and present technical reports, etc. She would become proficient in applying her knowledge of "avionics" and therefore advance to a Tier 3 level. (The employee may also have received a promotion to the GS-12 or GS-13 level.)

- After 7 or more years, the employee would take on more lead responsibilities and work on various projects. At this point, the employee decides whether to make a career change, or to continue to work in her professional field and further develop her expertise.

  ‣ If she decided to take a management position, then the employee starts her new career with a thorough understanding of the subject of "avionics" and plenty of real life experience. However, even though this is a promotion, it does not imply that she has advanced to being a subject matter expert. As a manager, she will begin to utilize and build expertise in other skills and competencies, such as leadership and project management. And depending on the position, she may not even utilize her avionics expertise anymore. So she would remain at a tier level 3 for this competency.

  ‣ If she decides to continue to work in her professional field, she may work on various other projects, move to different job positions, or take advanced academic courses. During this time, she would acquire new knowledge about avionics and computer systems and experience in applying that new knowledge. The employee would participate in Center, Agency or industry working teams or panels. All of this would help her to be recognized by her peers as a subject matter expert and therefore considered Tier Level 4.

Workforce Competency Dictionary

Tier Indicators Table

	TIER 1	TIER 2	TIER 3	TIER 4
Quick Reference	**Basic knowledge**	**Working knowledge**	**Proficient**	**Subject matter expert**
Definition	An individual has a basic knowledge of the subject matter and shows an awareness of how this competency relates to their job.	An individual has a working knowledge of the subject matter such that they are able to effectively apply that in their job.	Through the experience of applying their knowledge on the job, or other related activities, an individual has developed a thorough understanding of the subject matter AND is highly proficient in being able to apply that knowledge in their work environment.	Through years of experience, or advanced study, an individual has developed a comprehensive understanding of the subject matter and its interactions with other disciplines/competencies. The individual has advanced their set of skills to be able to apply their expertise to a multitude of projects and situations. The individual utilizes their in-depth knowledge to communicate and collaborate with peers within their normal work environment and outside to other professional business or technical communities.
Knowledge Measurements				
Use of Tools & Best Practices	Shows a basic knowledge of competency-related tools and best practices.	Exhibits ability to effectively use competency-related tools and best practices to perform their job.	Demonstrates skilled proficiency in their use of competency-related tools and best practices in their work environment.	Recognized by peers in their community and/or management, as having comprehensive knowledge of competency-related tools and best practices, how to apply them and how to improve them.
Knowledge and application of Policy & Standards & other documents	Shows a basic knowledge of competency-related policies, standards and other documentation..	Exhibits ability to effectively use their knowledge of competency-related policies, standards and other documentation to successfully perform their job.	Demonstrates skilled proficiency in their ability to incorporate their knowledge of competency-related policies, standards and other documentation to impact and modify systems and process in their work environment.	Recognized by peers in their community and/or management, for their expert ability to establish or modify competency-related policies, standards or technical specifications and/or development of other discipline related documentation utilized in their professional business or technical communities.
Information Collection & Analysis	Understand the basic information/data elements related to their competency.	Exhibits ability to effectively compile and analyze competency-related data for their job.	Demonstrates skilled proficiency in their ability to compile and summarize data, produce technical outputs and provide complex	Recognized by peers in their community and/or management for their ability to provide a comprehensive data analysis to determine performance of organization or discipline-related systems, processes

Quick Reference	TIER 1 Basic knowledge	TIER 2 Working knowledge	TIER 3 Proficient	TIER 4 Subject matter expert
			analysis for their work environment.	and events.
Problem Identification & Resolution	Shows an ability to review previously identified competency related problems and understand the applied solution.	Exhibits ability to effectively utilize their knowledge to routinely identify and solve work-related problems in their competency.	Demonstrates skilled proficiency in their ability to develop or change procedures/processes to resolve and/or prevent difficult technical/business issues.	Recognized by peers in their community and/or management for their comprehensive knowledge of the impact and interactions between multiple business/technical systems/processes that enables them to identify, assess and resolve complex technical or business problems.
Professional Development & Communication	Shows an ability to read and comprehend basic competency -related knowledge and information.	Exhibits ability to research, learn, and apply competency-related information to their job and effectively communicate that to peers in their professional community.	Demonstrates skilled proficiency in their ability to generate and present technical or functional documents and briefings to a variety of technical, functional, and/or management audiences.	Recognized by peers in their community and/or management for their comprehensive knowledge of the subject matter and their communication skills, they serve as an Agency, Center, and/or industry-wide resource for information and are often technical/business expert representatives on Center, Agency, industry, or academic working groups, boards, or panels.
Process/System Application, Assessment, & Integration	Shows a basic knowledge of competency-related processes/systems and the ability to follow prescribed procedures and implement plans.	Exhibits the ability to effectively utilize their knowledge to review and assess technical and/or business processes for impacts to the work flow.	Demonstrates skilled proficiency in their ability to apply their knowledge to assess and integrate across organizational, functional, or competency boundaries when developing or modifying business processes and/or technical systems.	Recognized by peers in their community and/or management for their expert ability to assess customer, system, or functional requirements in relation to their specific discipline and provide comprehensive solutions/products that meet the resource, technical, or situational constraints.

Appendix C: Revision Overview

Revision 6a Changes

NEW LEVEL 1 COMPETENCIES

Change#	CompID	Competency Title
528	175	Simulation Systems Competency
588	176	Legal Assistance

MODIFIED LEVEL 1 COMPETENCIES

Change#	CompID	Competency Title
520	121	Cost Estimation and Analysis
591	125	Legal Application Practice
524	89	Advanced Mission Analysis
551	39	Habitability and Environmental Factors
550	31	Cell & Molecular Biology

DELETED LEVEL 1 COMPETENCIES

Change#	CompID	Competency Title
552	33	Neurobiology

NEW LEVEL 2 COMPETENCIES

Change#	CompID	Parent Level 1 Competency	Level 2 Competency Title
533	1110	Control Systems, Guidance & Navigation	Control Components
534	1111	Control Systems, Guidance & Navigation	Control Electronics
501	1112	Legal Application Practice	International Law
614	1113		Commercial Law
590	1114	Legal Assistance	Patent Agent
602	1115	Human Capital Management	Classification
603	1116		Compensation
604	1117		Employee Benefits
605	1118		Employee Development
606	1119		Employee Relations
607	1120		Labor Relations
608	1121		Performance Management
609	1122		Recruitment/Placement
610	1123		Workforce Planning

MODIFIED LEVEL 2 COMPETENCIES

Change#	CompID	Parent Level 1 Competency	Level 2 Competency Title
589	1082	Legal Assistance	Paralegel
615	1083	Legal Application Practice	Intellectual Property Law
616	1084		General Law
617	1085		Contracts Law
618	1086		Personnel/EEO Law
619	1087		Environmental/Real Property

ADDITIONAL CHANGES

Change#	Competency Title
620	Remove the HCM sub competencies added in Revision 6. (ref DCR No 592-597). They will be replaced with 9 different HCM sub-competencies. (Ref DCR No 602-610)
565	Defer the change to delete "Detector Systems" The competency is to remain Active for Revision 6A and will be schedule for deletion in a future revision.

Revision 6 Changes

NEW LEVEL 1 COMPETENCIES

Change#	CompID	Competency Title
535	174	Student Trainee

MODIFIED LEVEL 1 COMPETENCIES

Change#	CompID	Competency Title
508	20	Sensors & Data Acquisition - Aeronautics
525	90	Aerospace Systems Concept Development & Technology Assessment
526	91	Advanced Analysis and Design Method Development
529	29	Quality Engineering & Assurance
530	27	Safety Engineering and Assurance
531	143	Fire Protection Engineering
532	150	Workplace Safety
544	80	Computer Systems and Engineering
566	62	Mechanics and Durability
568	101	Aerodynamics
572	109	Advanced Experimentation and Testing Technologies
573	2	Mission Flight Design
580	114	Process Engineering

DELETED LEVEL 1 COMPETENCIES

Change#	CompID	Competency Title
565	96	Detector Systems
567	63	Structural Systems

NEW LEVEL 2 COMPETENCIES

Change#	CompID	Parent Level 1 Competency	Level 2 Competency Title
536	1101	Student Trainee	Technical Student Trainee
536	1102		Clerical Student Trainee
536	1103		Professional Administrative Student Trainee
545	1104	Safety Engineering and Assurance	System Safety
546	1105		Probabilistic Risk Assessment
547	1106		Trend Analysis
548	1107		Precursor Analysis
585	1108	Rocket Propulsion	Solid & Hybrid Motor Systems
586	1109		Liquid Engine Systems

Change#	CompID	Parent Level 1 Competency	Level 2 Competency Title
592	-	Human Capital Management	Human Capital Leadership & Planning
593	-		Workforce Planning & Analysis
594	-		Workforce Recruitment & Retention
595	-		Workforce Learning & Capability Building
596	-		Leadership & Organization Development
597	-		Performance Culture & Workplace Environment

MODIFIED LEVEL 2 COMPETENCIES

Change#	CompID	Competency Title
539	1003	Work Performance Leadership

ADDITIONAL CHANGES

Change#	Competency Title
518	Move 5.1.8. Terrestrial & Planetary Environmental Science and Engineering (PLANETENV) [23] From the 5. Science Knowledge Domain To the 2. Engineering & Technology Knowledge Domain.
569	Move "Fluid Physics" (43) from section 2.11 Thermal/Fluid Competency Suite to section 5.3 Physical Sciences Suite
570	Move "Advanced Materials and Procesing Science" (65) from section 2.10 Structures, Materials mechanics competency suite to section 5.3 Physical Sciences competency suite.
571	Move "Electromagnetics" (12) from section 2.9 Sensor Systems competency suite to section 2.7 Electrical & Electronic competency suite.
511	Page 2 Item - 1.2.2.3 Assessment is misspelled as "Assesment
513	Page 69 - 71 Item - Captions Competencies is misspelled as "Comptencies"

Appendix D: Competency Tier Indicators

This section is to identify any additional indicators for a specified competency, as defined by the competency stakeholders and the appropriate agency professional community. When evaluating levels of expertise, these indicators are to be used in addition to the general tier indicators defined in Section B. If you have any questions, please contact the responsible competency stakeholders. (reference Appendix A)

ID	Competency	Tier Level	Indicator
125	Legal Application Practice	All	Member in good standing of the bar of either a Federal court or the highest court of any state in the United States or the District of Columbia.

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